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ABSTRACT

This guide is intended to assist vocational educators in providing job-relevant, performance-oriented training in small engine repair. The introductory section reviews procedures for using the guide. Provided next are instructional units dealing with the following topics: organizing and planning; supervising; selling lawnmowers, chain saws, and outboard motors; using a parts inventory; maintaining shop tools and equipment; servicing, maintaining, and repairing fuel systems; servicing and maintaining charging circuits, starting circuits, manual starters, and ignition systems; overhauling small engines; servicing and maintaining lawnmower assemblies, chain saw assemblies, and outboard engines, drives, and accessories; and servicing and repairing blade brake systems. Each unit consists of a series of duty sheets and a final performance checklist and test. Duty sheets contain some or all of the following: duty title; performance objective (broken down into a task, task performance standard, source of the standard, and task performance conditions); enabling objectives; recommended resources; suggested teaching activities; a criterion-referenced measure with answers; and a performance guide. Appendixes to the guide include a sequenced task list; definitions of relevant terms; a tool and equipment list; bibliographies of the sources of the standards included in the duty sheets, pertinent state-of-the-art literature, and materials recommended by the South Carolina Writing Team. (MN)

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V-TECS GUIDE
FOR
SMALL ENGINE REPAIR

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The Small Engine Repair V-TECS Guide was developed from the Small Engine V-TECS Catalog by a committee of Small Engine instructors in South Carolina. These instructors are to be commended for their expertise in the field and for their ability to complete the tedious work required in developing this V-TECS Guide. The writers are:

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INTRODUCTION

V-TECS guides are an extension or continuation of the V-TECS catalogs. While the V-TECS catalog is a composition of duties, tasks, performance objectives, and performance guides, it deals only with the psychomotor aspect of an occupation. It is a blueprint of an occupation. It deals only with the identification of the "hands on" aspect of the occupation. It does not take into consideration such things as the background information surrounding a task, how to make inferences, generalizations and decisions from a body of knowledge, nor does it deal with attitudes, job seeking skills, safety or energy conservation practices. V-TECS guides take these aspects of teaching and learning into consideration.

Experience has shown that the art of learning can also be taught while teaching subject matter. People need to learn how to learn. V-TECS guides take into consideration how students learn and are an efficient way for instructors to assist them to learn.

V-TECS guides are centered around all three domains of learning: psychomotor, cognitive, and affective. The following is a brief explanation of each.

Psychomotor

Any manipulative skill such as tightening a nut, replacing a hubcap, sharpening a pencil, machining a key slot in a steel shaft, or replacing a SCR in a solid state control panel are examples of manipulative or psychomotor skills. Tasks such as these are identified in V-TECS catalogs. V-TECS catalogs also group tasks by duties and objectives. Each performance objective has a performance standard which must be met to prove student proficiency in the manipulative aspect of the task. The V-TECS catalog, however, does not include any suggestions as to how to learn to do these tasks.

V-TECS guides are developed around psychomotor tasks which are worker oriented.

Cognitive

To perform psychomotor tasks, students must think. To tighten a nut they must know which way to turn it and when to stop turning it so that they won't strip the threads or shear the bolt off. If replacing a hubcap, there is a certain technique that may vary from one car to another. For example, start the hubcap by placing the cap in a tilted position and tapping it all the way around until it is properly seated. On a different model, it may be necessary to position the hubcap and snap it all at once. At any rate, students must think about what is being done. This is cognition or a mental activity. Cognition is what goes on in the mind about any job being done. V-TECS guides provide both the collateral knowledge and the impetus to apply cognition to psychomotor tasks.

Students gain cognition through both real and vicarious experiences. They may read, view tapes, memorize or practice a process or procedure until they are certain of it. To test their knowledge, students may be required to decide the proper procedure, method or sequence for performance. This is decision making or cognitive activity at it's highest.

Cognition, then, is that process by which information is stored and used. That voice that warns one of potential dangers is cognition. Anything that goes on in the mind is cognition. Students my become the best workers in their job; but is they fail to think a process through and apply their experience, they may become just one more statistic. It is cognition that tells them to lock and tag out the power supply to an electrical apparatus before starting to repair it. However, cognition does not apply only to safety. Good cognition or thinking can help employees do a job better and quicker. V-TECS guides provide for the cognitive aspects of learning.

Affective

Curriculum writers, supervisors, and instructors often fail to assist students in acquiring a positive attitude toward themselves, their jobs, their school, or their fellow students. V-TECS guides seek to provide assistance to the instructor in achieving this. It is difficult for the instructor to identify little bits and pieces of desirable behavior for every unit and often harder yet to teach them. In this area, students might be judged as to how well they clean up their work area, whether the show up to do the job on time, or whether they must be told several times to do something. Potential employers are interested in student attitude because persons angry at themselves or uncertain of themselves are often poor workers.

A student's ability to succeed on the first job and every job thereafter depends largely on attitude. If, for example, students have the attitude of "let someone else do it" they could be in trouble. Students using V-TECS guides will have activities dealing with how to get along with other students, supervisors, or staff members both in large and small groups.

USE OF V-TECS GUIDE

The guide is designed to provide job-relevant tasks, performance objectives, performance guides, resources, learning activities, evaluation standards and achievement testing in selected occupations.

A V-TECS guide is designed to be used with any teaching methods you may choose. If a lecture/demonstration method is best for you, you will find sufficient help to meet your needs. If you prefer to use discussions or other methods that require student participation, you will find ample help. Regardless of which method is successful for you, a V-TECS guide can save preparation time and offer innovative methods and procedures. For example, students may work either alone or in teams while in class and learn skills in direct relation to what is actually done on the job. This work also takes into consideration student attitudes, thinking skills, and mathematical reading skills.

The use of small groups in teaching can be helpful in two ways: (1) many students may feel inadequate due to their lack of background information in mechanical things: and (2) some students may feel that they are physically incompetent or lack the necessary background experiences. A successful program (course) can provide students with a sense of security by reinforcing positive attitudes while improving skill and knowledge of the subject. By allowing students to interact on a personal level, this task/learner-centered approach can achieve this. As students gain confidence and discover that they are an essential part of a team engaged in the learning-teaching process, their confidence increases. Too, the student in this setting can learn to work without direct supervision. In addition, use of the small-group method permits the instructor to vary instructional routines away from lecture or other full-class methods to activities for single students, pairs of students or any number so desired.

You will find suggestions for specific classroom activities. The activities are no meant to restrict you or your students, but only to suggest a variety of learning activities for each task statement. Please do not feel that you must take your students through all the activities.

ORGANIZING AND PLANNING

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 01

TASK: Calculate business expenses.

STANDARD OF PERFORMANCE OF TASK: The totals must be the same as those calculated by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Business records for any time period.

ENABLING OBJECTIVES:

1. Explain the meaning of credit.
2. Identify the need for credit.
3. Demonstrate the failings of credit.

RESOURCE:
Hoffman and Stewart. **General Recordkeeping,** pp. 55-60.

TEACHING ACTIVITIES:

1. Provide examples of different types of credit.
2. Discuss the different reasons for people wanting credit.
3. Explain the ways to check a person's past credit record.
4. Demonstrate different forms of recordkeeping.
5. Explain shop owner's recourse when credit goes bad.
6. Discuss credit versus cash for tax purposes.

CRITERION REFERENCED MEASURE:
Questions:

1. Which of the following is not a good place to check for credit?
    a. Merchant Bureau
    b. A past credit reference
    c. Employer
    d. A relative
2. Which type of credit is easier to keep track of?
    a. Open account/30 days.
    b. Revolving account
    c. Closed account-fixed time.
    d. Add on account.
3. What is one of the main problems with over extended credit?
    a. Lost money
    b. Lost business
    c. Angry people
    d. Bad debts

Answers:

1. b
2. a
3. b

PERFORMANCE GUIDE:

1. Calculate operating expenses.
2. Calculate equipment expenses.
3. Calculate parts expenses.
4. Calculate wage expenses.
5. Calculate miscellaneous expenses (advertising, etc.)
6. Total expenses for the period.

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 02

TASK: Calculate customer credit record.

STANDARD OF PERFORMANCE OF TASK: Computation must be identical to that of the instructor's.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A sample customer's credit record.

ENABLING OBJECTIVES:
1. Identify the work period.
2. Identify payroll period.

RESOURCE:
Baron, et al., **Practical Recordkeeping and Bookkeeping,** Unit 12, pp. 619-630.

TEACHING ACTIVITIES:
1. Discuss time cards and their use.
2. Identify different work categories.
3. Explain time and a half, double time and holiday pay.
4. Discuss starting and ending time limits.
5. Show a series of time cards and identify starting and ending, plus hours worked.
6. Explain manual time keeping.

CRITERION REFERENCED MEASURE:

Questions:
1. How many hours are in the following workday, 7:48-12:00, 1:00-5:28?
    a. 8
    b. 8 1/2
    c. 9
2. How many hours are to be paid at the overtime rate for 43 hours and 30 minutes?
    a. 3 1/2 hours
    b. 225 minutes
    c. 3 hours
3. Working 8 hours on a paid holiday equals how many hours of straight time?
    a. 16 hours
    b. 18 hours
    c. 20 hours

Answers:
1. b
2. a
3. c

PERFORMANCE OBJECTIVE V-TECS 02 (Continued)

PERFORMANCE GUIDE:

1. Locate customer credit record.
2. Enter charges, if any.
3. Enter payments, if any.
4. Compute new balance.

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 03

TASK: Calculate a daily or monthly cash balance.

STANDARD OF PERFORMANCE OF TASK: The figure calculated must be the same as that of the instructor's.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A beginning balance, credits and debits.

ENABLING OBJECTIVES:

1. Explain the meaning of "cash" to a business.
2. Figure multi-column addition and subtraction.
3. Identify the correct way to write a check.

RESOURCES:
Huffman, et al., **General Recordkeeping,** pp. 159-210.

TEACHING ACTIVITIES:

1. Explain the process of arriving at cash-on-hand.
2. Discuss the different types of payments received during a day.
3. Explain the use of credit cards and their status as a form of payment.
4. Explain the use of daily, weekly and monthly cash records for comparison.
5. Identify the items of a cash register printout at the end of a day.

CRITERION REFERENCED MEASURE:

Questions:

1. Identify three items shown on the cash register total printout.
    a. Total cash on hand, paid out, and beginning cash.
    b. Beginning cash, received on account, and cash sales.
    c. Total sales, total received on account, and total paid out.
2. Identify three types of payments.
    a. Sales on account, cash sale, and received on account.
    b. Beginning cash, cash sales, and cash paid out.
    c. Received on account, cash sales, cash paid out.
3. Beginning cash, plus cash sales, received on account, minus paid outs equals what?

Answers:

1. c
2. c
3. Cash on hand

PERFORMANCE GUIDE:

1. Secure all paper work affecting balance.
2. Enter beginning balance.
3. Add credits to balance.
4. Subtract debits from balance.
5. Enter results in final balance.

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 04

TASK: Maintain time record.

STANDARD OF PERFORMANCE OF TASK: The entries must be the same as those made by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A time record and simulated work information.

ENABLING OBJECTIVES:
1. Explain the meaning of expense.
2. Identify different types of expenses.
3. Demonstrate a two place decimal calculation.

RESOURCE:
Huffman and Stewart. **General Recordkeeping,** pp. 184-207.

TEACHING ACTIVITIES:
1. List expenses on board.
2. Separate expenses into groups. (operating, wages, parts, equipment, and miscellaneous)
3. Discuss cost of various expenses.
4. Explain the difference between wholesale and retail.
5. Demonstrate calculating the total of a group of expenses.
6. Discuss how to compare expenses with revenue.

CRITERION REFERENCED MEASURE:
Questions:
1. Which of the following are not expenses?
   a. Salaries
   b. Gasoline
   c. Truck
   d. Sparkplugs
2. Select the expense that does not belong in this group:
   a. Electricity
   b. Heat
   c. Rent
   d. Wrenches.
3. Which of the following is an operating expense?
   a. Window cleaning
   b. Spark plugs
   c. Wages
   d. Social Security

PERFORMANCE OBJECTIVE V-TECS 04 (Continued)

Answers:
1. c
2. d
3. a

PERFORMANCE GUIDE:
1. Enter time work began.
2. Enter work performed.
3. Enter time when work was completed.
4. Calculate time spent on task or projects.

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 05

TASK: Plan a daily or weekly work schedule.

STANDARD OF PERFORMANCE OF TASK: All work must be scheduled such that employees are performing tasks in accordance with their competencies at all times during their work periods, and such that jobs are scheduled in accordance with priorities assigned.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Sample appointments and work orders for a hypothetical small engine business.

ENABLING OBJECTIVES:

1. Record items sequentially.
2. Identify prices in a flat-rate schedule.

RESOURCES:
Flat-rate manual.

TEACHING ACTIVITIES:

1. Discuss the use of a flat-rate schedule vs. hourly charges.
2. Explain how to determine priorities.
3. Show how to determine the liability of estimates.
4. Discuss how to determine man hours available and assignments with a safety factor.
5. Demonstrate assigning work based upon flat-rate times and employees' work habits.

CRITERION REFERENCED MEASURE:

Questions:

1. Three working men give how many available man hours per five day week?
   a. 40
   b. 100
   c. 120
2. Shop rate is $20.00 per hour. Flat rate schedule is $1.75 hours. What is the estimated labor?
   a. $25.00
   b. $30.00
   c. $35.00
3. Two men working, which of the following schedules fills one day?
   a. 2, 4 1/2, 1 1/2, 5, and 3 hours
   b. 4, 1, 3, and 4 hours
   c. 1, 2, 4, 3, and 6 hours

PERFORMANCE OBJECTIVE V-TECS 05 (Continued)

Answers:

1. c
2. c
3. a

PERFORMANCE GUIDE:

1. Schedule appointments.
2. Schedule repair jobs.
3. Calculate the time necessary to complete the jobs scheduled.
4. Enter jobs on calendar.

DUTY: ORGANIZING AND PLANNING

PERFORMANCE OBJECTIVE V-TECS 06

TASK: Plan the layout of a small engine repair facility.

STANDARD OF PERFORMANCE OF TASK: The complete layout must be planned so that working conditions are safe and repairs proceed on schedule. See checksheet.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A hypothetical situation provided by the instructor.

ENABLING OBJECTIVES:

1. Identify square footage of classroom.
2. Compare work areas of different shops.
3. Measure and record measurements of several rooms (shops).

RESOURCE:
English and Metric Measuring Tools.
How States Plan for Job Safety and Health (OSHA 2050), May 1973.

TEACHING ACTIVITIES:

1. Discuss the area needed for various shop activities and OSHA regulations.
2. Explain safety needs for employees and customers.
3. Discuss utility needs and location.
4. Demonstrate foot traffic, restrooms, and retail needs on board.
5. Explain outside dimensions and limits of area/cost.

CRITERION REFERENCED MEASURE:

Questions:

1. According to classroom standards, what is the amount of storage area needed in relation to the total area?
    a. 10 percent
    b. 25 percent
    c. 40 percent
2. OSHA regulations refer to the design of:
    a. Restrooms
    b. Public health
    c. Employee safety.
3. Outside dimensions of 40 feet by 24 feet equal how many square feet?
    a. 816
    b. 960
    c. 808

Answers:

1. b
2. c
3. b

PERFORMANCE OBJECTIVE V-TECS 06 (Continued)

PRACTICAL APPLICATION:
Plan the layout of a small engine repair facility.

METHOD OF EVALUATION:
Use of checklist of Performance Objective 06 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 06 EVALUATION

PERFORMANCE TEST FOR PLANNING THE LAYOUT OF A SMALL ENGINE REPAIR FACILITY

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. There is adequate total space.	______	______
2. Facility meets OSHA Standards.	______	______
3. There is adequate lighting and ventilation.	______	______
4. Facility is neat.	______	______
5. Facility allows for growth.	______	______
6. Service area is convenient to parts storage area.	______	______
7. Sales area is convenient to office.	______	______
8. Parts can be located conveniently.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

SUPERVISING

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 07

TASK: Assign individual job positions.

STANDARD OF PERFORMANCE OF TASK: Skills possessed by each employee must be matched to the job requirements.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A hypothetical situation involving a number of workers with known abilities, and a number of jobs which require different competencies.

ENABLING OBJECTIVES:

1. Identify employee limitations.
2. Identify individual differences.

RESOURCES:

Christenson, et al., **Supervising,** pp. 302-303.
George, **Supervision in Action,** pp. 51-59.

TEACHING ACTIVITIES:

1. Explain that each employee has differences.
2. Have student discuss differences of employees.
3. Read information handout.
4. Discuss how each person should be considered.
5. Show that behavior is natural.
6. Have a student explain loyalty and how it is involved in performing a job.
7. Explain how jobs should be assigned to different individuals.

CRITERION REFERENCED MEASURE:

Questions:

1. Each employee should be considered as a/an __________ person.
    a. Loyal
    b. Individual
    c. Capable
2. Always try to _________ with the employee when a problem arises.
    a. Argue
    b. Disagree
    c. Empathize
3. ____________ should be assigned with regard to each employee's capabilities and individual needs.
    a. Activities
    b. Jobs
    c. Lessons

PERFORMANCE OBJECTIVE V-TECS 07 (Continued)

Answers:

1. a
2. c
3. b

PERFORMANCE GUIDE:

1. Assess competencies of employees.
2. Determine competencies needed to perform the job.
3. Assign jobs.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 08

TASK: Determine economic feasibility of repair.

STANDARD OF PERFORMANCE OF TASK: The decision reached will be the same as that of the instructor or experienced mechanic.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A defective engine, an equipment price list, parts price list and flat rate manual.

ENABLING OBJECTIVES:

1. Record items sequentially.
2. Identify prices in a flat-rate schedule.

RESOURCES:
Flat-rate manual.

TEACHING ACTIVITIES:

1. Discuss the use of a flat-rate schedule vs. hourly charges.
2. Explain how to determine priorities.
3. Show how to determine the liability of estimates.
4. Discuss how to determine man hours available and assignments with a safety factor.
5. Demonstrate assigning work based upon flat-rate times and employee's work habits.

CRITERION REFERENCED MEASURE:

Questions:

1. Three working men give how many available man hours per week?
   a. 40
   b. 100
   c. 120
2. Shop rate is $20.00 per hour. Flat rate schedule is 1.75 hours. What is the estimated labor?
   a. $25.00
   b. $30.00
   c. $35.00
3. With two men working, which of the following schedules fills one day?
   a. 2, 4 1/2, 1 1/2, 5, and 3 hours
   b. 4, 1, 3, and 4 hours
   c. 1, 2, 4, 3, and 6 hours

Answers:

1. c
2. c
3. a

PERFORMANCE OBJECTIVE V-TECS 08 (Continued)

PERFORMANCE GUIDE:

1. Determine the repairs needed.
2. Calculate the cost of repair.
3. Determine the cost of replacing the engine to be repaired.
4. Compare cost of repair and replacement.
5. Determine feasibility of report.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 09

TASK: Estimate total cost of repair.

STANDARD OF PERFORMANCE OF TASK: The estimate must be within + 5 percent of that determined by the instructor, or an experienced small engine supervisor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A small engine to be repaired, a parts price manual and a flat rate labor manual.

ENABLING OBJECTIVES:

1. Explain the meaning of expense.
2. Identify different types of expenses.
3. Figure a two place decimal calculation.

RESOURCES:
Huffman, et al., **General Recordkeeping,** pp. 184-207.

TEACHING ACTIVITIES:

1. List expenses on board.
2. Separate expenses into groups. (operating, wages, parts, equipment, and miscellaneous)
3. Discuss cost of various expenses.
4. Explain the difference between wholesale and retail.
5. Demonstrate calculating the total of a group of expenses.
6. Show how to compare expenses with revenue.

CRITERION REFERENCED MEASURE:
Questions:

1. Which of the following are not expenses?
    a. Salaries
    b. Gasoline
    c. Truck
    d. Sparkplugs
2. Select the expense that does not belong in this group:
    a. Electricity
    b. Heat
    c. Rent
    d. Wrenches.
3. Which of the following is an operating expense?
    a. Window cleaning
    b. Spark plugs
    c. Wages
    d. Social Security

PERFORMANCE OBJECTIVE V-TECS 09 (Continued)

Answers:

1. c
2. d
3. a

PERFORMANCE GUIDE:

1. Determine repair to be made.
2. Determine parts needed to repair.
3. Determine cost of parts.
4. Determine labor cost using a flat rate manual.
5. Total all expense (labor, parts and overhead).

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 10

TASK: Complete parts request.

STANDARD OF PERFORMANCE OF TASK: The form must be completed in such a manner that the parts request is not returned for clarification.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A parts request form and a description of parts to be ordered for a specific engine.

ENABLING OBJECTIVES:

1. Follow instructions.
2. Identify model number from engine.
3. Identify type number from engine.
4. Identify parts of an engine.
5. Identify parts in a catalog.
6. Identify part number from a parts catalog.

RESOURCE:
Purchase Requisition, South Carolina Department of Youth Services.
A Parts Catalog

TEACHING ACTIVITIES:

1. Describe how to read and find a part number in a parts catalog.
2. Discuss where to find model and type number on an engine.
3. Demonstrate completing a request form.
4. Discuss importance of completing form correctly.
5. Have student demonstrate completing a request form.

CRITERION REFERENCED MEASURE:

Questions:

1. To order parts for an engine, you must know the ________ and ________ of an engine.
2. It is essential that the part numbers be listed ____________.
3. Engine parts are listed in a ___________ ___________.

Answers:

1. Model and type
2. Correctly
3. Parts catalog

PERFORMANCE GUIDE:

1. Secure order form.
2. Obtain part number from the parts catalog.
3. List parts number on the request form.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 11

TASK: Conduct safety briefings on OSHA regulations.

STANDARD OF PERFORMANCE OF TASK: The briefing will be conducted in such a manner that when employees involved are asked to paraphrase any one of the major OSHA regulations, at least 80 percent of the group must do so with clarity, as judged by a supervisor other than the instructor delivering the briefing.

SOURCE OF STANDARD:
OSHA REGULATIONS -- 29 CRF1910
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A list of the ten major OSHA regulations.

ENABLING OBJECTIVES:

1. Read and interpret regulations chart.
2. Identify safety equipment.

RESOURCE:

South Carolina Department of Education, **Industrial Arts Safety Guide,** Student Manual, pp. 302-303.
How States Plan for Job Safety and Health (OSHA 2050)

TEACHING ACTIVITIES:

1. Conduct briefings on OSHA regulations.
2. Explain what OSHA means.
3. Discuss OSHA regulations.
4. Have student read pages in Industrial Arts Safety Guide.
5. Provide student with list of regulations.
6. Demonstrate safety equipment.
7. Discuss shop equipment and correct use.

CRITERION REFERENCED MEASURE:

Questions;

1. Always wear correct ___________ to help prevent accidents.
2. Proper ___________ is important in a work area to prevent inhaling of fumes.
3. Always wear ___________ to help protect the eyes.

Answers:

1. Clothing
2. Ventilation
3. Goggles

PERFORMANCE GUIDE:

1. List ten relevant OSHA standards.
2. Demonstrate selected safety hazards.
3. Conduct a shop tour to point out safety hazards.
4. Evaluate the effectiveness of the briefing.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 12

TASK: Calculate labor cost using a flat rate manual.

STANDARD OF PERFORMANCE OF TASK: The labor cost determined must be that obtained by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A list of job and a flat rate manual.

ENABLING OBJECTIVES:

1. State how to use a calculator.
2. Read and follow a flat rate manual instructions.

RESOURCE:

Standard Flat Rate Manual, Gravely Tractor Company, Form No. 16215L2 (4-73)

TEACHING ACTIVITIES:

1. Show and discuss a flat rate manual.
2. Illustrate using a flat rate manual.
3. Have student demonstrate using a flat rate manual.
4. Choose illustration from manual.
5. Complete illustration in amount of time given.

CRITERION REFERENCED MEASURE:

Questions:

1. __________, __________ and __________ determine the total job time.
2. __________ the total amount of time by the cost to find the total cost involved.
3. To calculate labor cost, use a __________ __________ __________.

Answers:

1. Hours, minutes, operation
2. Multiply
3. Flat rate manual

PERFORMANCE GUIDE:

1. List repairs to be done.
2. Use flat rate manual to determine allocated time.
3. Calculate the labor cost by multiplying hours spent by the hourly rate.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 13

TASK: Enter work performed on work orders.

STANDARD OF PERFORMANCE OF TASK: When completed, the form must not be returned by the instructor for clarification.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A work order form provided by the instructor.

ENABLING OBJECTIVES:

1. Identify engine information (manufacturer number and make).
2. Read and interpret a service manual.
3. Read and interpret a flat rate manual.
4. Read and interpret a parts catalog.
5. Identify listings on the order form.

RESOURCE:
Work Order Form. Gravely of Columbia, Inc.
A parts catalog.
A flat rate manual.

TEACHING ACTIVITIES:

1. Demonstrate how and where to list all owner and engine identification information.
2. Have student complete the owner and engine identification information.
3. Discuss how to determine if the work order is an estimate or warranty work order and how to list properly.
4. Demonstrate how to determine what service needs to be performed.
5. Discuss where on a work order form to list servicing or repairing.
6. Discuss parts that will be used and how to identify in a parts catalog.
7. Show where to list parts used.
8. Explain the amount of time it might take to do the job, refer to a flat rate manual, and a clock.
9. Show where to place amount of time used to repair/service on the work order form.
10. Explain and show students the claim check part of the work order form, why it is necessary, and what to do with it.

CRITERION REFERENCED MEASURE:

Questions:

1. The __________ and __________ number must be placed on a work order form.
2. The correct ____________ number must be listed on the work order form for new parts that were used.
3. The ___________ ___________ part of the work order is given to the owner when the owner brings the engine into the service shop to be repaired/serviced.

PERFORMANCE OBJECTIVE V-TECS 13 (Continued)

Answers:

1. Model, serial
2. Part
3. Claim check

PRACTICAL APPLICATION:

The work order form must list all necessary information so that the necessary work on the engine can be completed and the total cost listed.

METHOD OF EVALUATION:

Use of checklist of Performance Objective 13 is to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 13 EVALUATION

PERFORMANCE TEST FOR ENTERING WORK PERFORMED ON WORK ORDERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. All pertinent information was recorded on the work order form.	____	____
2. The repairs were recorded on the work order form.	____	____
3. The parts used were listed correctly on the work order form.	____	____
4. The amount of time taken to complete the job was recorded on the work order form.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 14

TASK: Post parts catalog.

STANDARD OF PERFORMANCE OF TASK: The added pages must be inserted in the catalog as specified by the publisher of the parts catalog.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A parts catalog and up-date bulletins for posting.

ENABLING OBJECTIVES:

1. Identify head listings on each page.
2. Correct numerical order.
3. Identify model number.

RESOURCE:

Service Bulletin, Kohler Company, Bulletin 2A-17.
A parts catalog.

TEACHING ACTIVITIES:

1. Explain to students what a parts catalog contains.
2. Explain the purpose of a parts catalog and how to identify parts.
3. Show a parts insert.
4. Demonstrate identifying parts listed on the insert.
5. Discuss where to locate identifying titles and necessary identification numbers.
6. Have student disassemble parts catalog.
7. Have student insert specified page into catalog.
8. Have student reassemble the parts catalog.

CRITERION REFERENCED MEASURE:

Questions:

1. A parts catalog is used to identify __________ of engines that come from the manufacturer.
2. A parts bulletin should be filed in ___________ order.
3. The ___________ number must be identified when inserting the bulletin into the parts catalog.

Answers:

1. Parts
2. Numerical
3. Model

PRACTICAL APPLICATION:
Place up-to-date parts and service bulletins into a parts catalog.

METHOD OF EVALUATION:
Use checklist of Performance Objective 14 to determine if the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 14 EVALUATION

PERFORMANCE TEST FOR POSTING PARTS CATALOG

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The parts bulletin was inserted into the catalog in the proper place.	______	______
2. The parts bulletins were inserted into the catalog as specified by the publisher of the parts catalog.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 15

TASK: Prepare a daily work control log or status board.

STANDARD OF PERFORMANCE OF TASK: The resultant posting must, without error, reflect the status of all work in progress.

SOURCE OF STANDARD:
South Carolina Writing Team.

ENABLING OBJECTIVES:

1. Use a flat rate manual.
2. Access time to perform a job.

RESOURCE:
Christenson, et al., **Supervising,** pp. 265-269.
A flat rate manual.

TEACHING ACTIVITIES:

1. Show a list of common repair or servicing jobs.
2. Explain how to use a flat rate manual.
3. Discuss how to check on available parts.
4. Explain the order in which jobs are to be performed.
5. Show a sample control log.
6. Give example of a repair job to be completed.
7. Have a student place an order on the control log.
8. Explain where to list jobs in which the parts are not available.
9. Have a student list jobs on the control log in the proper place.

CRITERION REFERENCED MEASURE:

Questions:

1. A ____________ ____________ will show when a repair job should be completed.
2. The availability of ____________ is important in completing a repair or service job promptly.
3. A control log should show the ____________ the repair order was completed.

Answers:

1. Control log
2. Parts
3. Date

PERFORMANCE GUIDE:

1. Prepare a list of all repair jobs.
2. List those jobs which must be delayed until parts arrive.
3. Post those repair jobs for which parts are available on the status board according to date received, or according to the assigned date of completion.
4. Post those jobs to be accomplished today under the today column.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 16

TASK: Orient newly hired personnel.

STANDARD OF PERFORMANCE OF TASK: New employee must be able to locate all major shop equipment and tools, list major types of operations and major employee expectations, and explain work order and parts department procedures.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A hypothetical situation provided by the instructor, orient a new employee.

ENABLING OBJECTIVES:

1. Read and interpret company procedures and policies.
2. Locate and describe all parts of a shop.

RESOURCE:
Christenson, et al., **Supervising**, pp. 321-325.
A sample work order.

TEACHING ACTIVITIES:

1. Discuss the welcome of new employees.
2. Have a student demonstrate welcoming a new employee.
3. Explain company procedures and policies of all departments.
4. Have a student discuss company policies and procedures.
5. Explain expectations of all new employees.
6. Tour a shop.
7. Discuss each department of a shop and discuss its function.
8. Show where all tools, equipment, catalogs, and paper work are located in a shop.
9. Have a student discuss the different work areas of a shop and what job is completed at each area.
10. Discuss how work is assigned.
11. Demonstrate how to complete a work order.
12. Have a student complete a work order.

CRITERION REFERENCED MEASURE:
Questions:

1. A nice _________ is important to a new employee and gives the employee added confidence.
2. Company policies and procedures should be explained to all new employees and given an Employee ___________ and ___________ Handbook.
3. A ___________ ___________ must be completed when a job has been assigned for servicing or repairing.

PERFORMANCE OBJECTIVE V-TECS 16 (Continued)

Answers:
1. Welcome
2. Policy and Procedure
3. Work order

PERFORMANCE GUIDE:
1. Introduce employees.
2. Tour shop -- show location of major equipment, work stations, parts, tools, manuals and parts catalogs.
3. Explain shop operations.
4. Explain employer expectations.
5. Explain method of assignments.
6. Explain work order procedures.
7. Explain parts department procedures.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 17

TASK: Prepare requisitions for shop equipment or tools.

STANDARD OF PERFORMANCE OF TASK: The request form must contain the quantity, quality and price of the items being requested, without error.

SOURCE OF STANDARD:
The South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The quality and quantity of tools and equipment to be ordered.

ENABLING OBJECTIVES:

1. Read and identify listings on a requisition form.
2. Identify where to place numbers and prices on the requisition form.
3. Use a calculator.
4. Read and interpret a tool and parts catalog.

RESOURCES:
A sample requisition form.
Industrial Products Catalog #844, Sears Roebuck and Co., pp. 15.

TEACHING ACTIVITIES:

1. Provide students with a sample requisition form.
2. Provide students with a sample tool catalog.
3. Demonstrate locating parts in a parts catalog.
4. Explain all parts to a requisition form.
5. Demonstrate how to complete the ordering of tools and equipment, including item number, quantity, description, unit price and total price.
6. Have a student demonstrate the ordering of equipment and tools.
7. Demonstrate how to find the total cost of an item being ordered.
8. Have a student demonstrate finding the total cost of items being ordered.

CRITERION REFERENCED MEASURE:

Questions:

1. When ordering tools and equipment, a ___________ number must be included.
2. List the amount of each item being ordered in the __________ selection.
3. Multiply the quantity and the unit price of an item to find the _________ cost of an item.

Answers:

1. Parts
2. Quantity
3. Total

PERFORMANCE GUIDE:

1. Obtain a list of equipment or tools needed.
2. Obtain a requisition form.
3. Obtain tool equipment numbers and prices from catalogs.
4. Complete the requisition form.

DUTY: SUPERVISING

PERFORMANCE OBJECTIVE V-TECS 18

TASK: Prepare and submit warranty claims.

STANDARD OF PERFORMANCE OF TASK: The report must contain all information required by the manufacturer such that reimbursement is received.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A warranty claim and a work order form.

ENABLING OBJECTIVES:

1. State how to use a calculator.
2. Follow instructions.
3. Identify correct forms.

RESOURCE:
Warranty Claim Report, Gravely Tractor Company, Columbia, S.C.

TEACHING ACTIVITIES:

1. Discuss the importance of reading the warranty card.
2. Explain information needed to complete a warranty claim report.
3. Review a sample claim report.
4. Demonstrate completing warranty claim report.
5. Have students complete a sample warranty claim report.

CRITERION REFERENCED MEASURE:

Questions:

1. A ____________ ____________ ____________ is used to send to a manufacturer to collect money, give credit, or replace a product.
2. If all necessary information is not listed on a warranty claim report, the report will be ____________.
3. Follow all ____________ in completing a warranty claim report.

Answers:

1. Warranty claim report
2. Unanswered
3. Instructions

PERFORMANCE GUIDE:

1. Determine if the repairs are covered by the warranty.
2. Obtain warranty repairs report.
3. Obtain a work order.
4. List parts used.
5. List time allowed by factory.
6. Complete a warranty report.

SELLING LAWN MOWERS, CHAIN SAWS AND OUTBOARD MOTORS

DUTY: SELLING LAWN MOWERS, CHAIN SAWS, AND OUTBOARD MOTORS

PERFORMANCE OBJECTIVE V-TECS 20

TASK: Calculate price to charge.

STANDARD OF PERFORMANCE OF TASK: The price determined should be the same as that computed by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The price list of an item, a sales discount chart, a state sales tax chart and a local sales tax schedule.

ENABLING OBJECTIVES:
1. Read and interpret a state sales tax chart.
2. Read and interpret a sales slip.
3. Read and interpret a discount chart.
4. Use a calculator.
5. Read and interpret a price list catalog.

RESOURCES:
1. A sales tax chart
2. A sales slip.
3. Gravely Tractor Co., **List Price Catalog,** pp. 1-14.

TEACHING ACTIVITIES:
1. Give students a sample sales slip.
2. Explain the parts of the sales slip that must be completed.
3. Show the list price of an item in a price catalog.
4. Demonstrate where to record the list price on the sales slip.
5. Demonstrate how to find the amount of state sales tax.
6. Have a student record the list price and the sales tax on the sales slip.
7. Explain a sales discount chart.
8. Show where to record the discount on a sales slip.
9. Demonstrate how to calculate the total price, including the list price, sales tax, and discount.
10. Have a student calculate the total price.

CRITERION REFERENCED MEASURE:
Questions:
1. To record the correct amount of sales tax on a sales slip, refer to a local ___________ ___________ chart.
2. The ___________ price is the price of the item being purchased.
3. The total price of an item includes the ___________ price, the local ___________ tax, minus a discount.

PERFORMANCE OBJECTIVE V-TECS 20 (Continued)

Answers:
1. Sales tax
2. List
3. List, sales

PERFORMANCE GUIDE:

1. Record the list price on a sales slip.
2. Deduct sales discount if discounts are given.
3. Compute state and local sales tax.
4. Calculate the total.

DUTY: SELLING LAWN MOWERS, CHAIN SAWS AND OUTBOARD MOTORS

PERFORMANCE OBJECTIVE V-TECS 21

TASK: Close a sale.

STANDARD OF PERFORMANCE OF TASK: The closing must be in accordance with the check sheet provided by the instructor. See checksheet.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary product knowledge and sales price.

ENABLING OBJECTIVES:
1. Use good customer relations.
2. Identify products.
3. Demonstrate properly.
4. Recognize how to record sale.

RESOURCE:
Mercury Outboards, Part No. 90-11310.

TEACHING ACTIVITIES:
1. Visit an outboard motor shop and observe the customers and salesperson.
2. Discuss how to approach a customer.
3. Demonstrate presenting the customer several product choices.
4. Have a student demonstrate presenting a product.
5. Discuss how to narrow the product choices with the customer.
6. Explain how to give a product demonstration.
7. Have a student discuss product choices.
8. Demonstrate making a product decision.
9. Show how to record a sale.
10. Explain how to inform the customer if there is a warranty.
11. Have a student record a sale and explain the warranty information.

CRITERION REFERENCED MEASURE:

Questions:
1. Hands on ____________ is important in selling a product to a customer.
2. A ___________ is when parts of a product will be replaced by the manufacturer, without charge, within a described period of time.
3. Always give the buyer a __________ __________ after a purchase has been made.

Answers:
1. Demonstration
2. Warranty
3. Sales slip

PERFORMANCE OBJECTIVE V-TECS 21 (Continued)

PRACTICAL APPLICATION:
Close a sale and give the buyer all the necessary information.

METHOD OF EVALUATION:
Use of checklist of Performance Objective 21 is to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 21 EVALUATION

PERFORMANCE TEST FOR CLOSING A SALE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	The customer was led to make a number of small but favorable decisions.	________	________
2.	The advantages of the product were worked into the conversation.	________	________
3.	Choices were narrowed.	________	________
4.	Items of interest to the customer were worked into the conversation.	________	________
5.	All choices were removed except one.	________	________
6.	Demonstrations were repeated.	________	________
7.	Opinion of others was solicited.	________	________
8.	Sale was recorded.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SELLING LAWN MOWERS, CHAIN SAWS AND OUTBOARD MOTORS

PERFORMANCE OBJECTIVE V-TECS 22

TASK: Complete a sales slip.

STANDARD OF PERFORMANCE OF TASK: The completed sales slip must be readable, free of mathematical error, and accurately reflect the sales transaction.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A sales slip and sales tax schedule.

ENABLING OBJECTIVES:

1. Read and interpret a parts catalog.
2. Read and interpret a price list.
3. Read a sales slip.
4. Read and use a calculator.

RESOURCES:

1. A sample sales slip.
2. A state sales tax schedule.

TEACHING ACTIVITIES:

1. Explain the parts of a sales slip.
2. Discuss how to use a sales tax table.
3. Discuss how and where to record the item being purchased.
4. Discuss how to record the cost of an item.
5. Explain how to record on the sales slip if a discount is applicable.
6. Discuss how to record the labor cost.
7. Have a student list the quantity on a sales slip.
8. Have a student complete the description.
9. Have a student complete the labor cost on a sales slip.
10. Have a student complete the sales tax.
11. Have a student add the sales tax and the cost of the item.

CRITERION REFERENCED MEASURE:

Questions:

1. A sales slip contains an item ___________, cost, ___________, labor cost, discount, ___________ tax and the total cost involved.
2. To find the amount of the sales tax due, use a ___________ ___________ ___________.
3. Look in the ___________ catalog to find the price of an item to list on the sales slip.

Answers:

1. Description, quantity, sales
2. Sales tax table
3. Parts

PERFORMANCE OBJECTIVE V-TECS 22 (Continued)

PERFORMANCE GUIDE:

1. List description of item.
2. Record quantity of item.
3. Record item cost.
4. Record item discount if applicable.
5. Record labor cost.

DUTY: SELLING LAWN MOWERS, CHAIN SAWS AND OUTBOARD MOTORS

PERFORMANCE OBJECTIVE V-TECS 23

TASK: Make a cash register entry.

STANDARD OF PERFORMANCE OF TASK: The entry must be made such that the amount recorded is the same as that deposited.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A cash register and a quantity to be entered.

ENABLING OBJECTIVES:

1. Read and interpret a sales tax table.
2. Locate price of item being paid for.
3. Identify the company identification number.

RESOURCE:
NCR Instruction Sheet No. 2114.

TEACHING ACTIVITIES:

1. Visit a small engine sales shop and observe the person operating the cash register.
2. Explain where to find the price and identification number on an item.
3. Show how to read a sales tax table.
4. Demonstrate how to operate a cash register.
5. Show how to enter the price, the identification number, and the sales tax amount into the cash register.
6. Explain and show how to find the total amount due.
7. Demonstrate telling the customer the total amount owed.
8. Have a student receive the money.
9. Have a student check the amount given.
10. Demonstrate how to enter the amount given into the cash register.
11. Check to see if any change should be given to the customer.
12. Explain that a receipt should always be given to the customer.
13. Have a student enter the amount of money given, the identification number, and the sales tax amount in the cash register. Find total amount.
14. Have a student give change to the customer.
15. Have a student give the customer a receipt.

CRITERION REFERENCED MEASURE:

Questions:

1. To find the amount of tax due on a sales item, look at a ___________ ___________ ___________.
2. To find the total amount owed when purchasing an item, add the ___________ of the item and the ___________ tax due.
3. Always be sure to give the customer a ___________ after a purchase has been made.

PERFORMANCE OBJECTIVE V-TECS 23 (Continued)

Answers:

1. Sales tax table
2. Cost, sales
3. Receipt

PERFORMANCE GUIDE:

1. Receive the money to be deposited.
2. Register this amount by pushing appropriate keys on the register.
3. Determine the amount of tax due (if tax is charged).
4. Register the amount of tax charged.
5. Close register.

USING A PARTS INVENTORY

DUTY: USING A PARTS INVENTORY

PERFORMANCE OBJECTIVE V-TECS 24

TASK: Maintain stock level of parts.

STANDARD OF PERFORMANCE OF TASK: The stock level must be maintained at the predetermined level recommended by the parts manufacturer or the employer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A stockroom inventory, card index and dealer listing.

ENABLING OBJECTIVES:

1. Read and identify a stockroom inventory.
2. Describe a dealer stock listing.

RESOURCE:
A dealer's stock listing.

TEACHING ACTIVITIES:

1. Lecture to students about the importance of maintaining a proper stock inventory.
2. Demonstrate to students how to inventory the parts that are on hand.
3. In a guided learning activity, show the students how to go over previous stock orders to identify any fast, or slow moving items.
4. Demonstrate to students how to properly fill out an order form.
5. Explain to students how important it is to keep inventory cards up to date at all times.

CRITERION REFERENCED MEASURE:

Questions:

1. A part was ordered six months ago; it is still on the shelf. Would you consider this part to be:
   a. A fast moving item
   b. A slow moving item
   c. A seasonal item
   d. Could be either b or c.
2. When ordering parts, they should always be ordered by:
   a. Manufacturer's part number
   b. Your stock number
   c. Both a and b
   d. None of the above.
3. Inventory cards:
   a. Should always match what is in stock
   b. Does not need to match what is in stock
   c. Is a record for the bookkeeper only
   d. Are used only if you don't use what is in stock.

PERFORMANCE OBJECTIVE V-TECS 24 (Continued)

Answers:
1. d
2. d
3. a

PRACTICAL APPLICATION:
Maintain a stock level as indicated by the instructor or by the manufacturer.

METHOD OF EVALUATION:
Use checklist of Performance Objective 24 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 24 EVALUATION

PERFORMANCE TEST FOR MAINTAINING STOCK LEVEL OF PARTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Maintain a stock level as indicated by the instructor or by the manufacturer.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student located the inventory card index.	____	____
2. The student observed the number recorded to indicate the quantity of a particular part in stock.	____	____
3. The student located the parts bin and counted the number of items in stock.	____	____
4. The student compared the number of parts recorded on the inventory card and the actual number of parts in stock and adjusted the number on the inventory card to match the number of parts in stock.	____	____
5. The student ordered the parts needed to maintain level recommended by manufacturer.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: USING A PARTS INVENTORY

PERFORMANCE OBJECTIVE V-TECS 25

TASK: Identify interchangeable parts.

STANDARD OF PERFORMANCE OF TASK: At least 95 percent of the parts to be interchanged must be correctly identified.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Access to a parts manual and interchange guide.

ENABLING OBJECTIVES:
1. Read and interpret a parts manual.
2. Read and interpret a parts interchange guide.

RESOURCE:
Manufacturer's parts manual.

TEACHING ACTIVITIES:
1. Lecture to students on how parts will and can interchange from one engine to another.
2. Explain to students how the proper and extensive use of an interchange guide can save them money by not having a lot of unnecessary parts on the shelf.
3. Demonstrate to the students how to properly use an interchange guide.
4. Demonstrate how two parts with two different part numbers are identical.
5. In a guided learning activity, allow students to look up parts in an interchange guide.

CRITERION REFERENCED MEASURE:
Questions:
1. When obtaining parts by using the interchange guide:
    a. The parts will be similar but will not be identical.
    b. The part numbers will be the same but not the parts.
    c. The part numbers will be different, but the part will be identical.
    d. None of the above.
2. Interchange guides are useful in helping:
    a. Keep stock lower.
    b. Obtain parts faster.
    c. Getting hard to find items.
    d. All of the above.
3. When looking for a part you should:
    a. Go to the interchange guide first.
    b. Find the part number in a regular parts book first.
    c. Just go to the parts room and hunt.
    d. Ask a friend.

PERFORMANCE OBJECTIVE V-TECS 25 (Continued)

Answers:

1. c
2. d
3. b

PERFORMANCE GUIDE:

1. Obtain parts interchange guide.
2. Obtain number of the part desired.
3. Using part number, obtain an interchange number if listed.
4. Record the interchange number on index card.

DUTY: USING A PARTS INVENTORY

PERFORMANCE OBJECTIVE V-TECS 26

TASK: Obtain parts from stockroom.

STANDARD OF PERFORMANCE OF TASK: The parts must be obtained within 10 percent of the time it would take the instructor or an experienced mechanic to obtain such parts.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A parts catalog or microfiche reader and an index to the inventory system.

ENABLING OBJECTIVES:

1. Read and interpret a parts catalog.
2. Describe a microfiche reader.

RESOURCE:
Manufacturer's Parts Catalog.

TEACHING ACTIVITIES:

1. Demonstrate how to locate the model number on engines.
2. Demonstrate how to find a part number using the model number and an illustrated parts breakdown.
3. Discuss the difference between a parts catalog and microfiche cards.
4. Instruct students on the layout of a parts room.
5. In a guided learning activity, have students look up and locate a given part.

CRITERION REFERENCED MEASURE:

Questions:

1. When looking up part numbers, it helps to have:
    a. Model number
    b. Serial number
    c. Part description
    d. All of the above.
2. Which of the following best describes the order of events of finding parts:
    a. Obtain part number, model number, description, and locate part.
    b. Obtain model number, part number, description, and locate part.
    c. Obtain description, model number, part number, and locate part.
    d. Obtain part number, price, description and locate part.
3. Microfiche systems have advantages over catalogs in that they are:
    a. Easier to store
    b. Easier to update
    c. Can be kept cleaner easier
    d. All of the above.

PERFORMANCE OBJECTIVE V-TECS 26 (Continued)

Answers:

1. d
2. c
3. d

PRACTICAL APPLICATION:
Given a part from the instructor, find its replacement within 10 percent of the time it would take an experienced person to find it.

METHOD OF EVALUATION:
Use checklist of Performance Objective 26 to determine if the assignment was completed with 10 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 26 EVALUATION

PERFORMANCE TEST FOR OBTAINING PARTS FROM STOCKROOM

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a part from the instructor, find its replacement within 10 percent of the time it would take an experienced person to find it.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 100 percent level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student identified parts using microfiche or parts catalog.	______	______
2. The student recorded the parts number.	______	______
3. The student located the part number in card inventory to determine availability and location.	______	______
4. The student obtained the part from stockroom.	______	______
5. The student subtracted the parts from the inventory.	______	______

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

MAINTAINING SHOP TOOLS AND EQUIPMENT

DUTY: MAINTAINING SHOP TOOLS AND EQUIPMENT

PERFORMANCE OBJECTIVE V-TECS 27

TASK: Clean a small engine repair shop.

STANDARD OF PERFORMANCE OF TASK: The entire shop must be free of excessive dust, debris, oil and or grease. Machinery and tools must be in place and free of excessive dust, debris, oil and grease.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools and supplies.

ENABLING OBJECTIVES:

1. Use basic tools and equipment.
2. Follow all safety precautions.

RESOURCE:
A laboratory or workshop arrangement schematic.

TEACHING ACTIVITIES:

1. Lecture to students on the need for a clean shop.
2. Discuss the safety aspect of having a clean and organized shop.
3. Demonstrate how to properly clean and place tools in their proper place.
4. Lecture to students on the mental reasons for keeping a shop clean.
5. In a guided learning activity, have the students clean and arrange the entire shop.

CRITERION REFERENCED MEASURE:

Questions:

1. When a shop is clean:
   a. It is safer to work in.
   b. You feel more like working in it.
   c. Quality of work is improved.
   d. All of the above.
2. When cleaning a shop you should:
   a. Never use gas for cleaning.
   b. Always use gas for cleaning.
   c. Store rags in the trash.
   d. Drain oil containers outside in a drain.
3. Cleaning hand tools should be done:
   a. On a grinder
   b. In a parts washer
   c. In the sink with soap and water
   d. Just put them up; they don't need to be cleaned.

PERFORMANCE OBJECTIVE V-TECS 27 (Continued)

Answers:

1. d
2. a
3. b

PERFORMANCE GUIDE:

1. Clean and return tools and equipment to proper location.
2. Clean work benches.
3. Dust machinery.
4. Store supplies.
5. Apply sweeping compound to floor.
6. Sweep floors.

DUTY: MAINTAINING SHOP TOOLS AND EQUIPMENT

PERFORMANCE OBJECTIVE V-TECS 28

TASK: Order bench stock.

STANDARD OF PERFORMANCE OF TASK: Only the stock ordered can be received, and it must not exceed by 10 percent the stock level dictated by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
An inventory of bench stock supplies.

ENABLING OBJECTIVES:

1. Read and interpret a supply catalog.
2. Read and interpret supply forms.

RESOURCE:
A laboratory or workshop inventory list.

TEACHING ACTIVITIES:

1. Discuss with students what is and what is not bench stock items.
2. Demonstrate how to inventory bench stock.
3. Discuss with students how to establish a need to add or delete items to bench stock listings.
4. Demonstrate how to fill out order requests for bench stock.
5. In a guided learning activity, have students stock items received.

CRITERION REFERENCED MEASURE:

Questions:

1. Bench stock items include all except:
    a. Bolts
    b. Cotter keys
    c. Sealant
    d. Hand tools.
2. When ordering bench stock you should order by:
    a. Part number
    b. Quantity
    c. Size and description
    d. All of the above.
3. Bench stock items should not be substituted unless:
    a. The substitution exceeds the previous quality.
    b. It is of lesser quality.
    c. You get a kickback from the company.
    d. That is all you can get.

PERFORMANCE OBJECTIVE V-TECS 28 (Continued)

Answers:

1. d
2. d
3. a

PRACTICAL APPLICATION:
Students will order bench stock so as not to exceed the quantity dictated by the instructor by 10 percent.

METHOD OF EVALUATION:
Use checklist of Performance Objective 28 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST R PERFORMANCE OBJECTIVE V-TECS 28 EVALUATION

PERFORMANCE TEST FOR ORDERING BENCH STOCK

Student's Name **Date**

DIRECTIONS TO STUDENT: Students will order bench stock so as not to exceed the quantity dictated by the instructor by 10 percent.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student determined the supply of bench stock.	________	________
2. The student prepared a list of bench stock needed.	________	________
3. The student obtained an order form.	________	________
4. The student completed an order form.	________	________
a. Recorded stock number.	________	________
b. Recorded stock quality (if applicable).	________	________
c. Recorded stock quantity.	________	________
d. Recorded stock size and description.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 29

TASK: Remove and clean fuel tank and fuel lines.

STANDARD OF PERFORMANCE OF TASK: The task must be completed within 10 percent of the time stated in a flat rate manual.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools and air compressor.
2. Identify the terminology of fuel systems.
3. Identify grades of oil.

RESOURCE:
Turner. **Small Engines Volume II.**, pp. 81-88.

TEACHING ACTIVITIES:

1. Read and discuss text, **Small Engines Volume II**, pp. 81-83.
2. Discuss the characteristics of a dirty fuel tank.
3. Demonstrate the reassembly and/or replacement of a fuel tank.
4. Discuss the importance of blowing out rust and sediment from the fuel system.
5. Have the students demonstrate their ability to clean a fuel tank and fuel line through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What safety precautions must be observed when working with gasoline?
2. How do you know when a metal fuel line is clear?
3. How do you determine if water is present in a fuel tank?

Answers:

1. Avoid making sparks near gas, strike no matches, light no cigarette lighters, and clean up gas spills immediately.
2. Fuel will flow through the line freely and without restriction.
3. Water in a fuel tank appears as bubbles in the bottom of the tank or on any hard surface the fuel is dumped on.

PRACTICAL APPLICATION:
Remove and clean a fuel tank and fuel line within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use checklist of Performance Objective 29 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 29 EVALUATION

PERFORMANCE TEST FOR CLEANING FUEL TANK AND FUEL LINE

Student's Name **Date**

DIRECTIONS TO STUDENT:	Remove fuel tank and fuel line and drain fuel tank. Examine tank for rust and clean tank and line with solvent. Blow out rust from tank and replace fuel tank and fuel lines.
DIRECTIONS TO EVALUATOR:	Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at an 80 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly removed the fuel tank and fuel line.	____	____
2. The student completely drained the fuel tank.	____	____
3. The student examined the tank for rust.	____	____
4. The student completely blew out all rust and sediment in fuel system.	____	____
5. The student replaced the fuel tank and fuel line.	____	____
6. The student tested the fuel system.	____	____
7. The student cleaned up the work area.	____	____
8. The student followed all safety instructions.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 30

TASK: Remove, clean and reinstall fuel filter systems.

STANDARD OF PERFORMANCE OF TASK: The task must be completed within 10 percent of the time stated in a flat rate manual.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools, solvent and rags.

ENABLING OBJECTIVES:

1. Proper use of hand tools and air compressor.
2. Identify the terminology of a fuel filter.

RESOURCE:
Turner. **Small Engines Volume I.** pp. 44-49.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines Volume I.** pp. 44-49.
2. Discuss the characteristics of a dirty fuel filter.
3. Demonstrate the reassembly and/or replacement of a fuel filter.
4. Discuss the importance of blowing out rust and sediment from a fuel filter.
5. Have the student demonstrate their ability to clean a fuel filter through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What safety precautions must be observed when working with gas and an air compressor?
2. How do you determine if the fuel filter is properly cleaned?
3. How do you determine the direction of fuel flow in a fuel filter?

Answers:

1. Avoid making sparks near gas, strike no matches or light no cigarette lighters, and clean up gas spills immediately.
2. Fuel will flow freely through the filter.
3. There is an arrow on the filter showing flow direction.

PRACTICAL APPLICATION:
Remove and clean a fuel filter within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use checklist of Performance Objective 30 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 30 EVALUATION

PERFORMANCE TEST FOR CLEANING A FUEL FILTER

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove fuel filter and clean it with solvent and compressed air. Replace fuel filter.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time at an 80 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly removed the fuel filter.	______	______
2. The student properly disassembled the fuel filter.	______	______
3. The student thoroughly cleaned filter in solvent.	______	______
4. The student properly reassembled filter assembly.	______	______
5. The student properly installed filter on engine.	______	______
6. The student cleaned up work area.	______	______
7. The student followed all safety instructions.	______	______

APPROVED: Yes ______ No ______

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 31

TASK: Service oil bath air cleaner.

STANDARD OF PERFORMANCE OF TASK: The oil used in the cleaner must be of the weight recommended by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Standard tool kit, solvent and clean motor oil.

ENABLING OBJECTIVES:

1. Proper use of hand tools and air compressor.
2. Identify the terminology of oil bath air filters.

RESOURCES:
Turner. **Small Engines Volume I.**, pp. 32-43.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines Volume I,** pp. 32-43.
2. Discuss the characteristics of a dirty air filter.
3. Demonstrate the reassembly of an air filter.
4. Discuss the importance of cleaning an air filter.
5. Have the students demonstrate their ability to clean an air filter through a teacher guided step-by-step process.
6. Discuss conditions under which the entire filter assembly should be replaced.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is a clean air filter so important in small engines?
2. How often should air filters be serviced?
3. What type of engine damage results from a clogged air filter?

Answers:

1. The life of the engine will greatly be reduced by not maintaining a clean filter.
2. At least every 25 hours of use or more often when dusty conditions are present.
3. Cylinder wall scuffing and scoring.

PRACTICAL APPLICATION:
Service an oil bath air cleaner using the manufacturer's recommended oil within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use checklist of Performance Objective 31 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 31 EVALUATION

PERFORMANCE TEST FOR SERVICING AN OIL BATH AIR FILTER

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove and clean an oil bath air cleaner and re-oil filter with correct oil. Reinstall filter.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at an 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly removed the air cleaner from the engine.	________	________
2. The student properly disassembled the air cleaner.	________	________
3. The student thoroughly cleaned the filter in solvent.	________	________
4. The student thoroughly blew the filter dry with compressed air.	________	________
5. The student filled filter to proper level with the recommended oil.	________	________
6. The student properly reinstalled the filter on the engine.	________	________
7. The student cleaned up the work area.	________	________
8. The student followed all safety instructions.	________	________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 32

TASK: Service the foam type air cleaner.

STANDARD OF PERFORMANCE OF TASK: The serviced air cleaner should allow air to flow freely to the carburetor so that the engine runs smoothly.

SOURCE OF STANDARD:

1. **Air Cooled Engine Mechanics Training Manual.** Engine Service Association
2. **Small Engines -- Volume I.** American Association of Agricultural Engineering and Vocational Agriculture
3. **Small Engines -- Volume II.** American Association of Agricultural Engineering and Vocational Agriculture.
4. **Small Engines Service Manual.** Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary hand tools, solvent and clean motor oil.

ENABLING OBJECTIVES:

1. Proper use of hand tools and air compressor and solvent.
2. Identify the terminology of foam type air filter.

RESOURCE:
Turner. **Small Engines, Volume I.** pp. 32-43.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume I,** pp. 32-43.
2. Discuss the result of running an engine with a dirty or clogged air filter.
3. Discuss the function of oil in a foam type air filter.
4. Demonstrate the reassembly of an air filter.
5. Have the student demonstrate their ability to clean an air filter through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What purpose does the oil serve in a foam type filter?
2. What can cause scuffing in an engine?
3. How does a dirty filter increase gas consumption?

Answers:

1. It traps the dirt in the filter.
2. A clogged air filter results in diluted oil on the cylinder wall.
3. The clogged air filter caused the engine to draw in more gas due to air flow intake restriction.

PRACTICAL APPLICATION:
Remove and clean a foam type air filter within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use checklist of Performance Objective 32 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 32 EVALUATION

PERFORMANCE TEST FOR CLEANING A FOAM TYPE AIR FILTER

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove a foam air filter and clean it in solvent and compressed air, oil element and squeeze oil evenly throughout filter. Reassemble and replace filter.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at an 80 percent proficiency level.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	The student properly removed the air filter assembly.	________	________
2.	The student properly disassembled the air filter.	________	________
3.	The student properly cleaned filter in solvent.	________	________
4.	The student properly rinsed and dried the element.	________	________
5.	The student properly oiled foam element and squeezed out excess oil.	________	________
6.	The student properly reassembled filter and installed same on carburetor.	________	________
7.	The student cleaned up work area.	________	________
8.	The student followed all safety instructions.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 33

TASK: Service the dry element air cleaner.

STANDARD OF PERFORMANCE OF TASK: The filter must be cleaned and installed so that air flows freely to the carburetor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools, air compressor, and solvent.
2. Identify the terminology of dry element air cleaner.

RESOURCE:
Turner. **Small Engines Volume I.** pp. 32-43.

TEACHING ACTIVITIES:

1. Read and discuss text, **Small Engines, Volume I,** pp. 32-43.
2. Discuss the result of applying oil or solvent to a paper element.
3. Discuss the importance of cleaning the area around the air cleaner.
4. Demonstrate the reassembly of the paper element filter assembly.
5. Have the student demonstrate their ability to clean an air filter through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What does oil do to the pores in some paper element filters?
2. Why are paper elements best cleaned by tapping them on a flat surface?
3. How do you determine if a paper element should be replaced?

Answers:

1. Oil stops the pores up.
2. Using compressed air may puncture the paper element.
3. Replace it if dirt doesn't drop off freely when it is tapped or if it is bent or damaged.

PERFORMANCE GUIDE:

1. Remove air cleaner from carburetor.
2. Using compressed air, blow dust and dirt from element.
3. Always blow from inside of the filter to the outside of the filter.
4. Reinstall.
5. Check.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 34

TASK: Disassemble, clean and reassemble a pulsation-type carburetor.

STANDARD OF PERFORMANCE OF TASK: The carburetor should function so the engine runs smoothly and accelerates smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and solvent.

ENABLING OBJECTIVES:

1. Proper use of hand tools and air compressor.
2. Identify the terminology of carburetors.
3. Recall disassembly steps in order to reassemble carburetor.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 86-97.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 93-97.
2. Discuss the function of each part of the carburetor.
3. Demonstrate the points of wear of the carburetor.
4. Discuss the importance of thoroughly cleaning all carburetor orifices and parts.
5. Demonstrate the reassembly/repair of the carburetor.
6. Have students demonstrate their ability to remove a carburetor from an engine, disassemble, clean, and reinstall carburetor-gas tank assembly on engine through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What purpose does the ball in the fuel pick-up tube serve?
2. What causes the gas in the fuel tank to be drawn up into the carburetor?
3. What controls the mixture of fuel and air that enters the engine?

Answers:

1. It prevents gas from flowing back down the tube.
2. The venture in the carburetor throat creates a low pressure, thus drawing the gas up the pick-up tube.
3. The needle valve mixture screw.

PRACTICAL APPLICATION:
Remove and clean a pulsation-type carburetor within 10 percent of the time stated in a flat rate manual. The engine should function smoothly and accelerate smoothly.

METHOD OF EVALUATION:
Use checklist of Performance Objective 34 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 34 EVALUATION

PERFORMANCE TEST FOR CLEANING A PULSATION-TYPE CARBURETOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove and clean a pulsation-type carburetor with solvent and compressed air. Reassemble and install carburetor on engine.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at an 80 percent proficiency level.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	The student properly removed the carburetor and gas tank from the engine.		
2.	The student properly removed the gas tank from the carburetor.		
3.	The student properly removed the fuel adjusting needle and seat and checked them for damage.		
4.	The student properly blew out, with compressed air, all orifices and fuel pipe and checked same for proper air flow.		
5.	The student properly checked the fuel pipe check-ball for correct operation.		
6.	The student checked all gaskets for damage and properly replaced any damaged gaskets.		
7.	The student properly reassembled the carburetor.		
8.	The student properly reassembled the carburetor to the fuel tank.		

PERFORMANCE OBJECTIVE V-TECS 34 CHECKLIST (Continued)

9. The student properly assembled the carburetor and gas tank to the engine. ________ ________

10. The student properly adjusted the carburetor so that the engine runs properly and accelerates smoothly. ________ ________

11. The student followed all safety instructions. ________ ________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 35

TASK: Disassemble, clean and reassemble a vacuum type carburetor.

STANDARD OF PERFORMANCE OF TASK: The carburetor must be reassembled so that the engine runs and accelerates smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:
1. Proper use of hand tools and air compressor.
2. Identify the terminology of carburetors.
3. Recall disassembly steps in order to reassemble carburetor.
4. Use of parts manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 86-97.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines, Volume II,** pp. 93-97.
2. Discuss the function of each part of the carburetor.
3. Demonstrate the points of wear of the carburetor.
4. Discuss the importance of thoroughly cleaning all carburetor orifices and parts.
5. Demonstrate the reassembly/repair of the carburetor.
6. Have students demonstrate their ability to remove a carburetor from an engine; disassemble, clean, and inspect the carburetor; reassemble/rebuild the carburetor; and reinstall carburetor-gas tank assembly on engine through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:
1. What are the names of the two holes under the needle valve seat of a Briggs and Stratton pulsa-jet carburetor?
2. Why must the choke butterfly close fully on these type carburetors?
3. What symptom is shown when a diaphragm has a hole in it?

Answers:
1. The high-speed and low-speed orifices.
2. The engine won't start unless the carburetor is fully chocked when starting.
3. The engine will run with the needle valve closed.

PERFORMANCE OBJECTIVE V-TECS 35 (Continued)

PERFORMANCE GUIDE:

1. Remove carburetor and gas tank from engine.
2. Remove carburetor from gas tank.
3. Remove fuel adjusting needle and seat.
4. Blow out jets and pick up tube making sure all are free of restrictions.
5. If the pick-up tube has a check ball, make sure that it is working freely.
6. Reassemble carburetor.
7. Assemble carburetor and gas tank.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 36

TASK: Disassemble, clean and reassemble a float-type carburetor.

STANDARD OF PERFORMANCE OF TASK: After adjustment and reassembly, the engine must run smoothly and accelerate smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:
1. Use of hand tools and air compressor.
2. Identify the terminology of carburetors.

RESOURCE:
Turner. **Small Engines, Volume II**, pp. 86-97.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines Volume II**, pages 83-93.
2. Discuss the function of each part of the carburetor.
3. Demonstrate the points of wear of the carburetor.
4. Discuss the importance of thoroughly cleaning all carburetor parts and orifices.
5. Demonstrate the reassembly/repair of the carburetor.
6. Have students demonstrate their ability to remove a carburetor and fuel tank from an engine; reassemble/rebuild the carburetor; clean fuel tank; and reinstall carburetor and gas tank on engine through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:
1. Why is the float setting so important?
2. How does a needle adjusting valve get grooved?
3. How can you easily remember how the governor and throttle linkage attach to the carburetor?

Answers:
1. If the float level is set too high, the carburetor will flood. If the float level is set too low, the engine will run out of gas under a full or partial load.
2. By being screwed in too tightly.
3. By tagging and labeling the parts as they are removed.

PERFORMANCE OBJECTIVE V-TECS 36 (Continued)

PERFORMANCE GUIDE:

1. Remove carburetor from engine.
2. Remove float bowl, float needle and seat.
3. Remove all adjusting needles.
4. Blow out all passages and jets with compressed air.
5. Check needles and seats for wear. Replace if worn.
6. Check float and float pin for damage or leaking.
7. Adjust carburetor float level.
8. Reassemble carburetor.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 37

TASK: Adjust carburetor float valve.

STANDARD OF PERFORMANCE OF TASK: The float valve should function so that the fuel level in the float bowl is maintained at the level specified by the manufacturer.

SOURCE OF STANDARD:

1. **Air Cooled Engine Mechanics Training Manual.** Engine Service Association, p. 156.
2. South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools and manufacturer's specifications.

ENABLING OBJECTIVES:

1. Proper use of mechanic's repair manual.
2. Identify the term parallel.

RESOURCE:
Turner. **Small Engines, Volume II,** pp. 86-97.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 88-93.
2. Discuss the function of the float in a float-type carburetor.
3. Demonstrate the proper method of setting the float of the carburetor.
4. Demonstrate the reassembly of the carburetor.
5. Have students demonstrate their ability to remove the carburetor from the engine, disassemble the carburetor, set the float properly, and reassemble the carburetor through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What part of the float is bent to set the carburetor float level?
2. Why must the tip of the inlet needle valve be closely inspected?
3. How do you check the float for leakage or being gas-saturated?

Answers:

1. The float tang is bent to set it properly.
2. The tip of the float will cause leakage if it is pitted or worn and if the rubber tip found on some needle valves is missing.
3. Submerge it in a liquid and watch for bubbles, by shaking it, and floating it in gas.

PERFORMANCE GUIDE:

1. Remove carburetor from engine.
2. Remove float bowl.
3. Adjust float to factory specifications. (Note: Usually the float will be set such that it is parallel to the rim of the carburetor body).
4. Reassemble the carburetor.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 38

TASK: Remove and reinstall a carburetor diaphragm.

STANDARD OF PERFORMANCE OF TASK: The diaphragm will meter fuel in such a manner that the engine runs smoothly and accelerates smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and equipment.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Identify the terminology of pulsa-jet carburetors.
3. Use of parts manuals.

RESOURCE:
Turner. **Small Engines, Volume II,** pp. 86-97.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 93-97.
2. Demonstrate the disassembly of the diaphragm type carburetor.
3. Discuss the function of the diaphragm.
4. Demonstrate the repair and reassembly of the carburetor.
5. Have students demonstrate their ability to remove the carburetor from the engine, disassemble the carburetor, inspect for wear, and reassemble carburetor through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why must a stiff diaphragm be replaced?
2. What symptom indicates when an engine is running that the diaphragm has a hole in it?
3. Why must the choke butterfly be held open when tightening the screws which hold the carburetor to the fuel tank?

Answers:

1. It won't allow fuel to flow freely in the carburetor.
2. The engine will run with the idle mixture valve closed and gas will shoot out of the carburetor throat.
3. To allow maximum travel of the diaphragm during operation.

PERFORMANCE GUIDE:

1. Remove carburetor if necessary.
2. Remove old diaphragm.
3. Inspect for stiffness or damage.
4. Replace worn parts.
5. Reassemble.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 39

TASK: Disassemble, clean and reassemble a fuel pump.

STANDARD OF PERFORMANCE OF TASK: The fuel pump must supply gasoline so that the engine runs smoothly and accelerates smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and equipment.

ENABLING OBJECTIVES:

1. Proper use of hand tools, air compressor, and solvent.
2. Use of parts manuals.

RESOURCES:
Turner. **Small Engines, Volume II,** pp. 83-97.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 83-96.
2. Demonstrate the disassembly of the fuel pump.
3. Discuss the operation of the fuel pump and its parts.
4. Demonstrate the reassembly and installation of the fuel pump.
5. Have students demonstrate their ability to remove the fuel pump, disassemble the pump, check for worn parts, and reassemble a fuel pump through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why should you mark the fuel pump housing sections?
2. What part does the camshaft lobe play in the fuel pump's operation?
3. What function does the diaphragm play in the fuel pump operation?

Answers:

1. The housings sometimes can be mounted in more than one position.
2. The cam lobe moves the pump cam lever which moves the diaphragm.
3. The movement of the diaphragm draws the gas from the fuel tank.

PERFORMANCE GUIDE:

1. Remove fuel pump from engine.
2. Clean all parts in solvent and dry.
3. Inspect diaphragm for damage or stiffness.
4. Replace worn parts.
5. Reassemble.
6. Install fuel pump on engine.

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 40

TASK: Fine tune carburetor.

STANDARD OF PERFORMANCE OF TASK:
The engine must idle, accelerate and run smoothly.

SOURCE OF STANDARD:
1. **Small Engine Service Manual.** Intertec Publishing Corporation.
2. South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Screwdriver or other tools if needed.

ENABLING OBJECTIVES:
1. Proper use of hand tools and tachometer.
2. Figure with fractions.
3. Read and interpret service manuals and service charts.

RESOURCE:
Turner. **Small Engines, Volume I.** pp. 102-109.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines Volume I,** pages 102-109.
2. Demonstrate how to properly close mixture valves and open them to specifications.
3. With engine running, demonstrate proper adjustment of high speed fuel mixture screw.
4. Demonstrate proper idle mixture adjustment.
5. Demonstrate proper idle speed adjustment.
6. Demonstrate proper engine acceleration.
7. Have the student demonstrate their ability to adjust a carburetor through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:
Questions:
1. What symptoms are present when the high speed mixture screw is adjusted too lean? Too rich?
2. What symptoms are present when the low speed mixture screw is adjusted too lean? Too rich?
3. Why should the air filter be installed on the carbureton when the carburetor adjustments are made?

Answers:
1. Engine spits, backfires, and hesitates upon acceleration. Engine runs "heavy" with black smoke coming out the muffler, won't develop peak rpm.
2. Engine won't idle smoothly, cuts off, skips. Black smoke, runs "heavy" on idle.
3. It decreases air intake and thereby changes the fuel-air mixture ration.

PERFORMANCE OBJECTIVE V-TECS 40 (Continued)

PRACTICAL APPLICATION:

Fine tune a carburetor so the engine idles smoothly at the correct rpm and accelerates smoothly and runs smoothly.

METHOD OF EVALUATION:

Use checklist of Performance Objective 40 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 40 EVALUATION

PERFORMANCE TEST FOR FINE TUNING A CARBURETOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Open low and high speed mixture screws 1½ turns from seat. Start engine and let it warm up. Run engine at 2500-3000 rpm and adjust high speed mixture screw until engine runs smoothly. Run engine at lowest rpm possible and adjust low speed mixture screw until engine runs smoothly. Set low speed idle to factory specifications.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at 100 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly set both high and low speed mixture screws at 1½ turns from seat.		
2. The student started engine and allowed it to warm up.		
3. The student ran engine at 2500 to 3000 rpm and properly set high speed mixture screw so that engine runs and accelerates smoothly.		
4. The student properly set the low speed mixture screw with the engine idling.		
5. The student properly set engine idle speed at factory specifications.		
6. The student properly made any further re-adjustments necessary for the engine to run smoothly.		
7. The student has cleaned up work area.		
8. The student followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING FUEL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 41

TASK: Clean crankcase breather.

STANDARD OF PERFORMANCE OF TASK: The breather must be free of all grease and dirt accumulations. Damaged breather valves must be identified and repaired or replaced.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools, solvent, and air compressor.
2. Identify the terminology of crankcase breathers.
3. Read and interpret parts manuals.

RESOURCE:
Turner. **Small Engines, Volume I.** pp. 50-56.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume I, pp. 50-56.**
2. Demonstrate removal and disassembly of crankcase breather.
3. Discuss characteristics of a worn or damaged breather part.
4. Demonstrate repair/replacement of crankcase breather.
5. Have student demonstrate their ability to clean and repair a crankcase breather through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why are some engines designed to operate with a slight crankcase vacuum?
2. What is the purpose of a crankcase breather?
3. What are some symptoms of an improperly functioning crankcase breather?

Answers:

1. It helps prevent oil leaks through oil seals and gaskets.
2. It prevents excessive crankcase pressure build-up and permits removal of crankcase vapors from the crankcase.
3. If the breather becomes clogged, oil seals and gaskets rupture and oil leaks develop. If the intake hose gets clogged, too much vacuum develops in the crankcase and dirt will be drawn through the oil seals, and gaskets are drawn into the engine.

PRACTICAL APPLICATION:
Remove and clean a crankcase breather. A defective breather must be identified and replaced. Work must be completed within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use checklist of Performance Objective 41 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 41 EVALUATION

PERFORMANCE TEST FOR CLEANING, CHECKING, REPLACING CRANKCASE BREATHER

____

Student's Name **Date**

DIRECTIONS TO STUDENT:	Remove and clean crankcase breather. Repair or replace any damaged breather.
DIRECTIONS TO EVALUATOR:	Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at an 80 percent proficiency level.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. The student properly cleaned the crankcase breather in solvent.	________	________
2. The student checked the breather for proper operation.	________	________
3. The student replaced or repaired any malfunctioning breather.	________	________
4. The student properly installed breather on engine and ran same.	________	________
5. The student cleaned work area.	________	________
6. The student followed all safety procedures.	________	________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

SERVICING AND MAINTAINING CHARGING CIRCUITS

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 42

TASK: Adjust cutout relay.

STANDARD OF PERFORMANCE OF TASK: The adjusted cutout relay must cut off at the voltage level specified by manufacturer.

SOURCE OF STANDARD:

1. **Chain Saw Service Manual.** Intertec Publishing Corporation.
2. **Outboard Service Manual, Vol. I.** Intertec Publishing Corporation.
3. **Outboard Service Manual, Vol. II.** Intertec Publishing Corporation.
4. **Small Engines — Vol. I.** American Association of Agricultural Engineering and Vocational Agriculture.

CONDITIONS FOR PERFORMANCE OF TASK:
A voltmeter and screwdriver.

ENABLING OBJECTIVES:

1. Read and interpret a manufacturer's specification chart.
2. Read a voltmeter.
3. Identify proper tools.
4. Follow proper adjustment procedure.

RESOURCE:
Service Manual, Kohler Co., Section K241 and K301, pp. 6-7.

TEACHING ACTIVITIES:

1. Explain the location and function of a cutout relay on an engine.
2. Demonstrate how to read a voltmeter.
3. Show diagram of a cutout relay. (In service manual)
4. Have student explain and show how to read a voltmeter.
5. Start an engine.
6. Demonstrate how to adjust a cutout relay.
7. Have student adjust a cutout relay.

CRITERION REFERENCED MEASURE:

Questions:

1. The cutout relay closes the circuit to the ___________ when the generator is running.
2. The ___________ ___________ opens the circuit when the generator stops.
3. Use a ___________ to turn the adjustment screw for the correct setting.

Answers:

1. Battery
2. Cutout relay
3. Screwdriver

PERFORMANCE OBJECTIVE V-TECS 42 (Continued)

PERFORMANCE GUIDE:

1. Obtain voltmeter.
2. With system in operation, check voltage at which relay will cut out.
3. If cutout is not correct, remove cover and adjust to manufacturer's specifications.
4. Replace cover.
5. Check voltage again after adjusting.

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 43

TASK: Check armature for short using an armature growler.

STANDARD OF PERFORMANCE OF TASK: The decision as to whether or not the armature is shorted must be the same as that of the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
An armature growler.

ENABLING OBJECTIVES:

1. Read and interpret a service manual.
2. Use an armature growler.
3. Use a voltage meter.
4. Read an ohmmeter.

RESOURCE:
Crouse, et al., **Small Engine Mechanics,** p. 217.

TEACHING ACTIVITIES:

1. Illustrate what an armature is and its location in the starter.
2. Demonstrate how to disassemble starter to find the armature.
3. Discuss and show the necessary tools.
4. Demonstrate how to use the necessary tools.
5. Have student locate and test armature with the correct tools.

CRITERION REFERENCED MEASURE:

Questions:

1. The ____________ is the part of a starter that you put in a growler.
2. In order to get to the armature, you must disassemble the ____________.
3. To check an armature for shorts, you use a ___________ and an ___________.

Answers:

1. Armature
2. Starter
3. Growler, ohmmeter

PRACTICAL APPLICATION:
Check an armature for a short using an armature growler.

METHOD OF EVALUATION:
Use of checklist of Performance Objective 43 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 43 EVALUATION

PERFORMANCE TEST FOR CHECKING ARMATURE FOR A SHORT USING AN ARMATURE GROWLER

Student's Name **Date**

DIRECTIONS TO STUDENT; Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. A growler was used to check the armature.	________	________
2. The proper tools were used.	________	________
3. The growler met the manufacturer's specifications.	________	________
4. The growler was inspected to see if it needed replacing.	________	________
5. The student checked for a shortage in the armature.	________	________
6. The work area was cleaned.	________	________
7. Safety precautions were taken.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 44

TASK: Check and replace field winding if necessary.

STANDARD OF PERFORMANCE OF TASK: Ohm reading must be within the range established by the manufacturer.

SOURCE OF STANDARD:

1. **Chain Saw Service Manual.** Intertec Publishing Corporation.
2. **Outboard Service Manual, Vol. I.** Intertec Publishing Corporation.
3. **Outboard Motor Service Manual, Vol. 2.** Intertec Publishing Corporation.
4. **Small Engines Service Manual.** Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
An ohmmeter, assorted wrenches and screwdriver.

ENABLING OBJECTIVES:

1. Read a manufacturer's service manual.
2. Read an ohmmeter.
3. Identify parts of a starter.
4. Identify special tools.

RESOURCES:
Crouse, et al., **Small Engine Mechanics,** p. 193.

TEACHING ACTIVITIES:

1. Show how to use a tester to determine if the starter is defective.
2. Have a student demonstrate how to test a starter.
3. Demonstrate how to disassemble a starter.
4. Explain the function of the parts that have been disassembled.
5. Show the field windings.
6. Test all the parts that have been disassembled to see if they are defective or can be reused.
7. Show how to replace defective parts with new parts.
8. Have a student test parts.
9. Show how to reassemble the starter.
10. Have a student reassemble the starter.

CRITERION REFERENCED MEASURE:

Questions:

1. The two major parts of a starter motor are the __________ and the __________ __________.
2. Current enters the motor and passes through the __________ __________.
3. Use an __________ to test the current flow in the field windings.

PERFORMANCE OBJECTIVE V-TECS 44 (Continued)

Answers:
1. Armature, field windings
2. Field windings
3. Ohmmeter

PRACTICAL APPLICATION:
Given correct tools, check and/or replace field windings so that the ohm reading is within the given manufacturer's specifications.

METHOD OF EVALUATION:
Use the checklist of Performance Objective 44 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 44 EVALUATION

PERFORMANCE TEST FOR CHECKING AND REPLACING FIELD WIRING IF NECESSARY

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The proper tools were used.		
2. The parts were removed to gain access to the field windings.		
3. Both ends of the field windings were disconnected.		
4. The wires were tested to check for a broken circuit.		
5. An ohmmeter was used to check for a short.		
6. The wiring was replaced or repaired, if defective.		
7. The field windings were reassembled properly.		
8. All safety precautions were taken.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 45

TASK: Clean commutator.

STANDARD OF PERFORMANCE OF TASK:
The commutator must collect and transmit the induced current.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools, No. 00 sandpaper and a brush.

ENABLING OBJECTIVES:

1. Read and interpret a service manual.
2. Identify proper tool assortment.
3. Identify a commutator.
4. Use testing equipment.

RESOURCE:
Crouse, et al., **Small Engine Mechanics,** p. 193.

TEACHING ACTIVITIES:

1. Explain the location of a commutator on a starter.
2. Discuss the function of a commutator.
3. Show how to disassemble a commutator.
4. Demonstrate how to test all parts.
5. Show how to clean the commutator.
6. Have a student clean the commutator.
7. Demonstrate how to reinstall the armature.
8. Have a student demonstrate installing the armature.

CRITERION REFERENCED MEASURE:

Questions:

1. The commutator is cleaned with ___________ sandpaper and a ___________.
2. The commutator is a part of the ___________.
3. _____________ flows through a segment of the commutator.

Answers:

1. .00, brush
2. Armature
3. Current

PERFORMANCE GUIDE:

1. Remove armature from generator.
2. Clean grooves in commutator.
3. Polish commutation if discolored by heat.
4. Reinstall the armature.

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 46

TASK: Check and replace generator or starter brushes.

STANDARD OF PERFORMANCE OF TASK: The decision to replace must be the same as that of the instructor. The generator will produce specified current and the starter will function as an electric motor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Assorted wrenches and screwdrivers and a set of new brushes.

ENABLING OBJECTIVES:

1. Read and interpret a parts manual.
2. Read and interpret a service manual.
3. Identify generator parts.
4. Identify proper tools.

RESOURCES:

Service Manual, Kohler Co., Bulletin No. 77, p. 3.

TEACHING ACTIVITIES:

1. Discuss information sheet in the **Service Manual,** p. 3.
2. Explain special tools that will be needed.
3. Demonstrate how to disassemble a generator.
4. Demonstrate how to disassemble starter brushes from a generator.
5. Demonstrate how to inspect for possible wear or defects.
6. Have a student disassemble a generator.
7. Have a student identify the generator parts.
8. Have a student inspect all parts and replace if necessary.
9. Demonstrate how to reassemble the generator.
10. Check to see if the generator will produce specified current.

CRITERION REFERENCED MEASURE:

Questions:

1. In order to inspect or replace starter brushes, the ___________ must be disassembled.
2. The brushes are used in the ___________ and ___________ to create current to the starter.
3. Brushes are placed on top of the ___________ in a starter generator.

Answers:

1. Starter
2. Generator, starter
3. Commutator

PRACTICAL APPLICATION:

Disassemble a generator to see if the starter brushes are defective, worn, or need replacing. After replacing, the generator should produce the necessary current so that the starter will function as an electric motor.

METHOD OF EVALUATION:

Use of checklist of Performance Objective 46 to determine if the assignment was completed with at least a 95 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 46 EVALUATION

PERFORMANCE TEST FOR CHECKING AND REPLACING A GENERATOR OR TRACTOR BRUSHES

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 95 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The proper tools were used.		
2. The starter was removed properly.		
3. The parts blocking access to the brushes were removed.		
4. The parts were inspected visually.		
5. The proper testing equipment was used.		
6. The brushes were removed properly.		
7. The brushes were checked for wear.		
8. The brushes were reassembled correctly.		
9. The generator and starter performed properly.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 47

TASK: Replace alternator/generator bearings or bushings.

STANDARD OF PERFORMANCE OF TASK: The replaced bearing or bushings must allow the armature to turn freely without dragging or binding on field coils.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Assorted tools and the bearings or bushings needed.

ENABLING OBJECTIVES:

1. Read and follow manufacturer's specification chart.
2. Tools and necessary equipment.

RESOURCES:
Crouse. **Automotive Mechanics,** Seventh Edition, p. 295.

TEACHING ACTIVITIES:

1. Provide alternator/generator for demonstration.
2. Discuss tools that will be needed.
3. Have students identify tools that will be needed.
4. Identify the parts of the alternator/generator.
5. Show how to remove bearings or bushings.
6. Have students demonstrate removal of bearings or bushings.

CRITERION REFERENCED MEASURE:

Questions:

1. Both the __________ and the __________ produce electric current.
2. __________ and __________ are used on an armature in a generator/alternator.
3. The purpose of the alternator is to __________.

Answers:

1. Alternator, generator
2. Bearings, bushings
3. Charge battery

PERFORMANCE GUIDE:

1. Remove alternator or generator from engine.
2. Remove pulley from alternator/generator.
3. Disassemble generator/alternator to gain access to bearings and/or bushings.
4. Remove bearings and/or bushings.
5. Replace bearings and/or bushings.
6. Reassemble the generator or alternator.
7. Reinstall unit on equipment.

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 48

TASK: Troubleshoot the charging circuit using a manufacturer's guide.

STANDARD OF PERFORMANCE OF TASK: The trouble or troubles identified must be the same as those determined by the instructor. Troubles must be identified within twenty minutes of the time required by the instructor or an experienced mechanic.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A voltmeter, manufacturer's specifications and manufacturer's troubleshooting procedures.

ENABLING OBJECTIVES:

1. Read a voltmeter.
2. Read and interpret a manufacturer's specification chart.
3. Read and interpret a troubleshooting guide.

RESOURCE:

Engine, Technical Information, Kohler Co., p. 21.
Manufacturer's Specification Chart.

TEACHING ACTIVITIES:

1. Show how to read a voltmeter.
2. Demonstrate how to read a manufacturer's specification chart.
3. Demonstrate how to interpret a troubleshooting guide.
4. Show parts of a charging circuit.
5. Have student read a voltmeter.
6. Have student identify a problem using the troubleshooting guide.
7. Demonstrate troubleshooting a charging circuit.
8. Have student demonstrate troubleshooting the charging circuit.

CRITERION REFERENCED MEASURE:

Questions:

1. A charging system consists of a __________, __________, __________, and connecting wiring.
2. Always follow the __________ __________ when the charging circuit does not perform properly.
3. Use a __________ to check the amount of current being used.

Answers:

1. Battery, regulator, generator
2. Troubleshooting guide
3. Voltmeter

PERFORMANCE OBJECTIVE V-TECS 48 (Continued)

PRACTICAL APPLICATION:
Troubleshoot the charging circuit using a voltmeter and a manufacturer's specification guide.

METHOD OF EVALUATION:
Use of checklist of Performance Objective 48 to determine if the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 48 EVALUATION

PERFORMANCE TEST FOR TROUBLESHOOTING THE CHANGING CIRCUIT USING A MANUFACTURER'S GUIDE

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. A voltmeter was used.	________	________
2. A manufacturer's specification manual was used.	________	________
3. Parts were tested to see if they needed replacing.	________	________
4. The output of the charging circuit was checked.	________	________
5. The output met manufacturer's specifications.	________	________
6. The charging circuit was performed to the manufacturer's specifications.	________	________
7. All safety precautions were taken.	________	________

APPROVED: Yes ____ No ______

____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 49

TASK: Inspect and replace belt pulley and belt.

STANDARD OF PERFORMANCE OF TASK: The decision to replace must be the same as that of the instructor. The belt and/or pulley must be replaced such that the accessory or components attached operate without excessive slippage and without excessive pressure on the pulley or bearings.

SOURCE OF STANDARD:

1. **Outboard Service Manual, Vol. I.** Intertec Publishing Corporation.
2. **Outboard Motor Service Manual, Vol. 2.** Intertec Publishing Corporation.
3. **Small Engines Service Manual.** Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools and replacement parts.

ENABLING OBJECTIVES:

1. Identify a belt and pulley.
2. Identify proper hand tool assortment.
3. Identify wear on belt/pulley.
4. Read and interpret a service manual.

RESOURCES:

Lawn and Garden Equipment Repair, Stillwater, Okla., p. LG-23-G.
Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. Demonstrate how to disconnect the spark plug wire and connect to a ground.
2. Demonstrate how to remove belt guards and shields.
3. Demonstrate how to release belt tension.
4. Have a student inspect belt for swells or lumps, breaks, and broken cords.
5. Have a student inspect drive pulley for damage, excessive wear and alignment.
6. Demonstrate how to replace belt and/or pulley.
7. Have a student replace belt and/or pulley.
8. Show how to adjust belt tension to the manufacturer's specifications.
9. Have a student adjust belt tension to the manufacturer's specifications.
10. Demonstrate how to reconnect the spark plug wire.
11. Have a student start the engine to see if it performs.

CRITERION REFERENCED MEASURE:

Questions:

1. The ___________ and ___________ must be removed to be inspected for wear or damage.
2. The belt and pulley must be ___________ properly to prevent damage to the belt, pulley and bearings.
3. The ___________ must be adjusted properly for the engine to perform.

Answers:

1. Belt, pulley
2. Aligned
3. Tension

PERFORMANCE GUIDE:

1. Visually inspect belts and pulleys for obvious defects or wear.
2. Replace pulley if defective or worn.
3. Replace belt if defective or worn.
4. Adjust belt.

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 50

TASK: Replace alternator.

STANDARD OF PERFORMANCE OF TASK: The replaced alternator must be installed so that all pulleys are aligned, belts are at recommended tension, and alternator output is sufficient to charge the battery.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools.

ENABLING OBJECTIVES:

1. Prepare use of hand tools.
2. Read a tester.
3. Read a tension gauge.
4. Read and interpret a manufacturer's specification chart.

RESOURCES:

1. **Power Mechanics Curriculum Guide,** p. 163.
2. Crouse, **Automotive Mechanics,** p. 280.
3. Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. Discuss alternator parts.
2. Show how to realign belts.
3. Show how to straight edge align pulley.
4. Check belt tension with a tension gauge.
5. Show how to adjust to manufacturer's specifications.
6. Emphasize safety regarding belts and pulleys.

CRITERION REFERENCED MEASURE:

Questions:

1. ___________ and ___________ should be aligned to maintain tension.
2. To remove an _______________, first you should disconnect the battery cables.
3. If you do not have ___________ in the right position, the alternator will not perform properly.

Answers:

1. Belts, pulleys
2. Alternator
3. Cables

PRACTICAL APPLICATION:
Replace alternator and check input and output.

METHOD OF EVALUATION:
Use of Checklist Performance Objective 50 to determine the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 50 EVALUATION

PERFORMANCE TEST FOR REPLACING AN ALTERNATOR

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student used proper safety equipment.	______	______
2. The student connected the battery and alternator properly.	______	______
3. The student adjusted the belts and pulleys to the right tension.	______	______
4. Student followed manufacturer's specifications.	______	______
5. The student followed proper safety procedures.	______	______

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 52

TASK: Replace voltage regulator.

STANDARD OF PERFORMANCE OF TASK: The regulator must not allow a deficit or an exchange of the current flow specified by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools and a voltmeter.

ENABLING OBJECTIVE(S):

1. Follow safety procedures.
2. Identify correct tools.
3. Follow proper removal and replacing of wires.

RESOURCES:
Service and Repair Instructions, Briggs and Stratton Corp., p. 43.

TEACHING ACTIVITIES:

1. Discuss the function of a regulator.
2. Explain location of regulators on engines.
3. Demonstrate how to remove regulator from an engine.
4. Have student remove regulator from an engine.
5. Discuss proper replacing of a regulator.
6. Have student replace regulator.

CRITERION REFERENCED MEASURE:
Questions:

1. Check voltage in a regulator using a ___________.
2. All ___________ must be installed in the proper sequence.
3. Regulators are ____________ found in the same location on an engine.

Answers:

1. Voltmeter
2. Wires
3. Seldom

PRACTICAL APPLICATION:
Replace regulator so that it does not ground out against the side of the engine.

METHOD OF EVALUATION:
Use of Checklist Performance Objective 52 to determine the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 52 EVALUATION

PERFORMANCE TEST FOR REPLACING A VOLTAGE REGULATOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Regulators were bolted to the engine correctly.	______	______
2. Wires were connected to regulator properly.	______	______
3. Battery cables were connected properly.	______	______
4. Safety precautions were taken.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHARGING CIRCUITS

PERFORMANCE OBJECTIVE V-TECS 53

TASK: Replace diode assembly.

STANDARD OF PERFORMANCE OF TASK: The diode assembly must be replaced such that the direction of current is changed from AC to DC.

SOURCE OF STANDARD:
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary hand tools and an ohmmeter.

ENABLING OBJECTIVES:
1. State the function of a diode.
2. Locate a diode on an engine.
3. Read an ohmmeter.

RESOURCES:
Crouse, et al., **Small Engine Mechanics,** p. 267.

TEACHING ACTIVITIES:
1. Explain what a diode is and how it operates.
2. Show how to locate a diode.
3. Illustrate how to use and read an ohmmeter.
4. Discuss the function of a diode on an engine.
5. Demonstrate how to disconnect the diode from the wiring harness.
6. Have a student test to see if the diode is defective.
7. Show how to reconnect the diode to the wiring harness.
8. Have a student reconnect the diode.

CRITERION REFERENCE MEASURE:

Questions:
1. A diode rectifies the ___________ current to ___________ current.
2. Diodes are sometimes mounted in a bracket called a ___________ ___________.
3. Use an ___________ to test the current through a diode.

Answers:
1. AC, DC
2. Heat sink
3. Ohmmeter

PRACTICAL APPLICATION:
Use an ohmmeter to test a diode and replace it so that the current is changed from AC to DC.

METHOD OF EVALUATION:
Use of Checklist Performance Objective 53 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 53 EVALUATION

PERFORMANCE TEST FOR REPLACING A DIODE ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Parts were removed that blocked access to the diode assembly.	______	______
2. The wires were removed in the proper order.	______	______
3. The diode was removed properly.	______	______
4. The diode was checked to see if it needed replacing.	______	______
5. An ohmmeter was used to check the current.	______	______
6. The diode was replaced properly.	______	______
7. The wires were reassembled in the proper order.	______	______
8. The output met the manufacturer's specifications.	______	______
9. The work area was cleaned.	______	______
10. All safety precautions were taken.	______	______

APPROVED: Yes ______ No ______

Evaluator's Signature **Date**

SERVICING AND MAINTAINING THE STARTING CIRCUIT

DUTY: SERVICING AND MAINTAINING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 54

TASK: Charge a battery.

STANDARD OF PERFORMANCE OF TASK: The battery should be charged such that it is restored to the recommended specific gravity.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A voltmeter, hydrometer, battery charger and other tools and supplies as needed.

ENABLING OBJECTIVES:

1. Identify necessary hand tools.
2. Read a hydrometer and a voltmeter.
3. State how to use a tester.
4. Identify positive and negative clamps.
5. Check electrolyte level in all cells.
6. Use a battery charger.

RESOURCE:
Crouse, et al., **Small Engine Mechanics,** pp. 178-187,

TEACHING ACTIVITIES:

1. Show and discuss parts of a battery.
2. Demonstrate how to check the battery with a hydrometer.
3. Demonstrate how to check electrolyte level and water level.
4. Explain the various factors that affect the specific gravity of the electrolyte,
5. Demonstrate how to recharge a battery.
6. Have student recharge battery.

CRITERION REFERENCED MEASURE:

Questions:
Fill in blanks:

1. A ___________ will explode if the ___________ are not connected to the battery correctly.
2. To check the specific gravity in a battery, you must use a ___________.
3. Never allow _____________ to get on your hands or body.

Answers:

1. Battery, clamps
2. Hydrometer
3. Acid

PERFORMANCE OBJECTIVE V-TECS 54 (Continued)

PERFORMANCE GUIDE:

1. Check water level.
2. Check charge using hydrometer or voltmeter.
3. Clean terminals.
4, Remove battery caps before charging.
5. Attach charger.
6. Set charging time. and turn charges on.

   Note: Hydrogen gas is emitted from the battery during the charging operation. A flame or spark near the battery could result in a fire or explosion.

DUTY: SERVICING AND MAINTAINING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS SCO1

TASK: Rebuild starter

STANDARD OF PERFORMANCE OF TASK:
Starter must be rebuilt to manufacturer's specifications.

SOURCE OF STANDARD:
Writing Team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Starter, hand tool assortment, armature grounder and test light, solvent and parts brush or rag, ignition wrench set, safety glasses, safe workbench -- free of flammable liquids.

ENABLING OBJECTIVES:

1. Identify all parts of a starter.
2. Use the proper tools.
3. Read an ohmmeter.

RESOURCES:

Hires, et al., **Comprehensive Small Engine Repair,** pp. 181C-185C, SE-193-C
Crouse, et al., **Small Engine Mechanics,** pp. 188-202.

TEACHING ACTIVITIES:

1. Discuss function of a starter and its parts.
2. Identify parts of a starter.
3. Demonstrate how a starter works on an engine.
4. Explain how to disassemble and test parts.
5. Have student disassemble, test, replace defective parts and recheck starter.
6. Have student place starter back on engine.

CRITERION REFERENCED MEASURE:

Questions:

1. A __________ is necessary in a direct-current motor.
2. If the design of a starter allowed two identical magnetic poles to align opposite (180° apart) the __________ will not spin.
3. In order to remove the brushes from a __________, the whole starter must be disassembled.

Answers:

1. Commutator
2. Armature
3. Cap

PRACTICAL APPLICATION:
Rebuild starter to meet manufacturer's specifications.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SCO1 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS SCO1 EVALUATION

PERFORMANCE TEST FOR REBUILDING A STARTER

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	The student used the right tools.	________	________
2.	The student disassembled all necessary parts.	________	________
3.	The student cleaned all parts.	________	________
4.	The student tested all parts.	________	________
5.	The student kept parts in right order and ready to reassemble.	________	________
6.	The student reassembled starter so that it performed correctly.	________	________
7.	The student followed all safety procedures.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 55

TASK: Trouble-shoot starting circuit.

STANDARD OF PERFORMANCE OF TASK: The troubles identified will be the same as those determined by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A hydrometer, VOM meter, wiring diagrams, and engine with a starting circuit, and a manufacturer's repair manual.

ENABLING OBJECTIVES:

1. Read a hydrometer.
2. Read a VOM Meter.
3. Read and interpret a manufacturer's repair manual.
4. Identify all parts of a starting circuit.
5. Identify necessary tools.
6. Explain the functions of a starting circuit.

RESOURCE:

Crouse, et al., **Small Engine Mechanics,** Chapter 22.
A Manufacturer's Repair Manual.

TEACHING ACTIVITIES:

1. Show a chart on a starting circuit.
2. Explain necessary tools that will be needed.
3. Show how to read a hydrometer and a volt ohmmeter.
4. Explain starting circuit parts and what each does.
5. Have student demonstrate how to read a hydrometer and a volt ohmmeter.
6. Explain the wiring system to a starting circuit.
7. Show how to read and interpret a manufacturer's repair manual.
8. Demonstrate how to test all parts of the starting circuit.
9. Explain why different parts may not operate properly.
10. Have student determine, using correct tool, if parts are defective.

CRITERION REFERENCED MEASURE:

Questions:

1. A ___________ is used to check the specific gravity of a battery cell.
2. The purpose of the ___________ is to make it possible for the starter switch to be located some distance away from the battery and starter.
3. The ___________ furnishes the electricity to operate a motor.

Answers:

1. Hydrometer
2. Solenoid
3. Battery

PRACTICAL APPLICATION:
Student will demonstrate, using all necessary tools, how to troubleshoot the starting circuit.

METHOD OF EVALUATION:
Use of Checklist Performance Objective 55 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 55 EVALUATION

PERFORMANCE TEST FOR TROUBLESHOOTING A STARTING CIRCUIT

Student's Name **Date**

DIRECTIONS TO STUDENT:	Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.
DIRECTIONS TO EVALUATOR:	Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED		Satisfactory	Unsatisfactory
1.	The battery was charged properly.	______	______
2.	The battery cables were tightened.	______	______
3.	The starter circuit was working properly.	______	______
4.	The solenoid was working properly.	______	______
5.	The starter was engaging the flywheel properly	______	______
6.	The proper tools were used.	______	______
7.	The student followed the repair manual.	______	______
8.	The work area was cleaned.	______	______
9.	Safety precautions were taken.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

SERVICING AND MAINTAINING MANUAL STARTERS

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 56

TASK: Check manual starter for proper operation.

STANDARD OF PERFORMANCE OF TASK: The defects identified must be the same as those of an instructor or an experienced mechanic.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A manual and all necessary tools.

ENABLING OBJECTIVES:
1. Proper use of hand tools and solvent.
2. Read and interpret service manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 8-26.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines, Volume II,** pp. 8-26.
2. Demonstrate a properly functioning recoil spring and starter dog or pawl.
3. Demonstrate a properly functioning drive hub or cup and ratchet.
4. Demonstrate the proper disassembly of a recoil starter.
5. Demonstrate the proper assembly of a recoil starter.
6. Have the student demonstrate their ability to check a manual starter for proper operation through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:
Questions:
1. What safety precautions must be carefully observed when working with starter springs?
2. Why must the engaging points of starter dogs and pawls be kept sharp?
3. What failure occurs when the starter cup or hub wall becomes grooved by the starter dogs or pawls?

Answers:
1. Safety goggles must be worn when working with starter springs.
2. They won't bite into the hub or cup well enough to turn the engine over.
3. The pawls or dogs won't bite into the hub or cup wall well enough to turn the engine over.

PRACTICAL APPLICATION:
Check a manual recoil starter for proper operation. Any defects found must be the same as those identified by the instructor. Work must be completed within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use Checklist Performance Objective 56 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 56 EVALUATION

PERFORMANCE TEST FOR CHECKING MANUAL AND RECOIL STARTER FOR PROPER OPERATION

Student's Name **Date**

DIRECTIONS TO STUDENT: Check a recoil starter for the following: rope recoils completely, dogs or pawls engage starter cup firmly, dogs or pawls are not rounded on ends, and ratchet assembly engages and disengages flywheel properly.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	The student properly checked for recoil spring rewinding rope completely.		
2.	The student properly checked drive mechanism for sufficient engagement in the starter hub.		
3.	The student properly checked the engaging points of starter pawls or dogs for square edges.		
4.	The student checked ratchet assembly for proper engagement and disengagement of flywheel.		
5.	The student followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 57

TASK: Replace a defective starter spring.

STANDARD OF PERFORMANCE OF TASK: The replaced starter spring will completely recoil the rope.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools and solvent.
2. Read and interpret parts manuals.
3. Identify shop safety techniques.

RESOURCE:
Turner. **Small Engines Volume II,** pp. 8-26.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines Volume II,** pp. 8-26.
2. Demonstrate the disassembly of a recoil starter.
3. Describe the characteristics of a defective starter spring.
4. Demonstrate the reassembly of a recoil starter.
5. Have the student demonstrate their ability to identify and replace a defective starter spring through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What is the purpose of the starter spring?
2. How do you restore tension in a Briggs and Stratton recoil spring?
3. What should you never do if you find a recoil spring is in its own holder?

Answers:

1. To recoil the starter rope.
2. Tension is restored by straightening out the spring.
3. You should never try to remove the spring from its holder.

PRACTICAL APPLICATION:
Replace a defective starter spring within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use Checklist Performance Objective 57 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 57 EVALUATION

PERFORMANCE TEST FOR REPLACING A STARTER SPRING

Student's Name **Date**

DIRECTIONS TO STUDENT: Wearing eye protection, remove starter from engine and unwind spring tension. Remove pulley retaining screw and pulley. Inspect spring and replace it if necessary. Reassemble starter.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at 100 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student has removed the starter from the engine properly.	______	______
2. The student removed the rope from the starter assembly without letting the pulley unwind too rapidly.	______	______
3. After putting on eye protection, the student removed the pulley retaining screw and pulley.	______	______
4. After inspecting defective spring student replaced the spring.	______	______
5. The student reassembled starter assembly.	______	______
6. The student reinstalled the starter assembly and lubricated spring.	______	______
7. The student cleaned up the work area.	______	______
8. The student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 58

TASK: Replace starter clutch if needed.

STANDARD OF PERFORMANCE OF TASK: The replaced clutch will engage the crankshaft when the starter rope is pulled and completely disengage when the rope is released.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A manufacturer's manual, a spanner wrench, and nut driver.

ENABLING OBJECTIVES:

1. Proper use of hand tools and safety equipment.
2. Read and interpret service manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 8-26.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 22-23.
2. Discuss the characteristics of a worn or defective starter clutch.
3. Demonstrate the disassembly, inspection, cleaning, and reassembly of a starter clutch.
4. Discuss the importance of not lubricating the starter clutch.
5. Have the students demonstrate their ability to repair or replace a starter clutch through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What function do the steel balls serve in the starter clutch?
2. Why must no lubrication be placed inside the starter clutch?
3. How does the clutch disengage after the engine is started?

Answers:

1. The ratchet wedges them against the starter clutch body, thereby engaging the starter and crankshaft to turn the engine.
2. The lubrication will prevent the steel ball from engaging and disengaging.
3. Centrifugal force throws the balls to the outside of the clutch housing and out of contact with the ratchet.

PERFORMANCE GUIDE:

1. Remove blower or starter housing.
2. Remove screen.
3. Remove clutch.
4. Remove dust screen.
5. Visually inspect clutch housing for obvious defect or wear.
6. Replace blower housing.

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 60

TASK: Replace starter pawls if needed.

STANDARD OF PERFORMANCE OF TASK: The replaced pawls must function such that when the rope is pulled the starter is engaged and does not slip. When the rope is released the starter will fully disengage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Snap ring pliers, nut driver, and a manufacturer's repair manual.

ENABLING OBJECTIVES:
1. Proper use of hand tools.
2. Read and interpret parts and service manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 14-26.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines, Volume II,** pp.20-22.
2. Discuss the characteristics of a worn starter pawl.
3. Demonstrate the disassembly, inspection, cleaning, repairing, and reassembly of a recoil starter assembly.
4. Discuss the function of each part in the recoil starter assembly.
5. Have the students demonstrate their ability to replace a starter pawl through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:
Questions:
1. Which parts cause the starter pawl to engage the starter cup wall?
2. What function does the starter pawl spring serve.
3. What causes the starter pawl to wear?

Answers:
1. The friction spring, starter pulley, and friction cup.
2. The starter pawl spring holds the starter pawl in the disengaged position when the engine starts and while the rope rewinds.
3. The sharp corner of the starter pawl repeatedly hitting the starter cup wall.

PERFORMANCE GUIDE:
1. Remove starter from housing.
2. Remove retaining clip or screw.
3. Remove pawls from starter housing.
4. Visually inspect pawls for obvious defects or wear.
5. Replace starter pawls if needed.
6. Reassemble starter.

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 62

TASK: Replace a worn or defective cup.

STANDARD OF PERFORMANCE OF TASK: The pawls will engage without slippage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
An impact wrench, micrometer, and a manufacturer's manual.

ENABLING OBJECTIVES:

1. Proper use of hand tools and measuring devices.
2. Read and interpret parts and service manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 14-26.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 20-22.
2. Discuss the characteristics of a worn or defective starter cup.
3. Demonstrate the removal, inspection, and measurement of a starter cup.
4. Discuss the causes of starter cup wear.
5. Have the students demonstrate their ability to replace a starter cup through a teacher directed step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why does a starter cup wear?
2. What are the symptoms of a starter that has a worn starter cup?
3. Why do starter cups have notches on their flywheel side?

Answers:

1. The sharp edge of the starter dog cuts into the inside of the cup thereby wearing the metal surface slowly away.
2. The dog, when activated by pulling the rope, slips against the starter cup wall. The starter doesn't "catch" anything.
3. To prevent the cup from turning on the flywheel.

PRACTICAL APPLICATION:
Replace a worn or defective starter cup within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use Checklist Performance Objective 62 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 62 EVALUATION

PERFORMANCE TEST FOR REPLACING A WORN STARTER CUP

Student's Name ______________________ **Date** __________

DIRECTIONS TO STUDENT: Remove starter and starter cup from engine. Visually inspect cup for defects and measure cup for wear. Replace cup if needed and reinstall starter.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Word should be completed in a reasonable time limit at a 100 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student removed the starter from the engine.	______	______
2. The student removed the starter cup from the engine.	______	______
3. The student visually inspected the cup for wear.	______	______
4. The student measured the cup for wear.	______	______
5. The student determined if cup needs replacement and acted accordingly.	______	______
6. The student reinstalled starter assembly on engine.	______	______
7. The student cleaned work area.	______	______
8. The student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature ______________________ **Date** __________

DUTY: SERVICING AND MAINTAINING MANUAL STARTERS

PERFORMANCE OBJECTIVE V-TECS 63

TASK: Replace starter rope.

STANDARD OF PERFORMANCE OF TASK: The starter rope must completely rewind without binding and be of sufficient length to insure a full smooth pull.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools and materials.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Read and interpret parts manual.
3. Follow proper shop safety techniques.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 14-26.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 14-26.
2. Discuss the characteristics of a worn or defective starter rope.
3. Demonstrate the removal, inspection, and replacement of a starter rope.
4. Discuss the causes and results of starter rope wear.
5. Have the student demonstrate their ability to replace a starter rope through a teacher directed step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What damage may result to a starter if the rope is allowed to wear to the point of breaking?
2. What are some causes of starter rope wear?
3. Why must the ends of the new rope be burned?

Answers:

1. Upon breaking, the broken starter rope allows the recoil spring to suddenly unwind completely, thereby causing the spring to wind partially in the wrong direction. This results in damage or breakage of the spring end at the pulley.
2. Poorly tuned engine, improperly pulling the starter rope, wrong size or length rope.
3. To keep the rope from coming unbraided and the knot from coming untied.

PERFORMANCE OBJECTIVE V-TECS 63 (Continued)

PERFORMANCE GUIDE:

1. Remove starter from engine.
2. Release spring tension.
3. Remove knot.
4. Remove rope from pulley.
5. Install new rope in pulley.
6. Burn rope at end.
7. Tie simple knot in rope.
8. Add spring tension to pulley.
9. Reassemble starter to engine.
10. Check for proper operation.

SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 64

TASK: Install spark plugs.

STANDARD OF PERFORMANCE OF TASK: The plugs must be gapped and torqued in accordance with manufacturer's specifications.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools and manufacturer's specifications.

ENABLING OBJECTIVES:

1. Proper use of hand tools and measuring devices.
2. Read and interpret repair manuals and wall chart specifications sheet.
3. Read and interpret spark plug replacement guide.

RESOURCE:
Turner. **Small Engines, Volume I.** pp. 74-85.

TEACHING ACTIVITIES:

1. Read and discuss textbook **Small Engines, Volume I,** pp. 74-85.
2. Discuss the characteristics of a worn or defective spark plug.
3. Demonstrate the removal, gapping, replacement, and torquing of a spark plug.
4. Discuss the importance of starting the installation of a spark plug by hand.
5. Have the student demonstrate their ability to remove, inspect, and replace a spark plug through a teacher directed step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is the condition of the spark plug so important?
2. Why is the spark plug gap important?
3. Why should a spark plug be started by hand when being installed?
4. Why are spark plug heat range and reach important?

Answers:

1. It gives you important clues to the engine's condition; ring wear, ignition point wear, leaking valves, etc.
2. If the gap is set too wide, the engine may be hard to start; set too close the engine will lack power.
3. To prevent cross threading the plug.
4. The wrong heat range can damage the piston and valves. The wrong reach plug may damage piston and valves.

PERFORMANCE OBJECTIVE V-TECS 64 (Continued)

PRACTICAL APPLICATION:
Install a spark plug to manufacturer's specifications within 10 percent of the time stated in a flat rate manual.

METHOD OF EVALUATION:
Use Checklist Performance Objective 64 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 64 EVALUATION

PERFORMANCE TEST FOR INSTALLING A SPARK PLUG

____

Student's Name **Date**

DIRECTIONS TO STUDENT:	Remove spark plug and determine plug condition. After selecting the proper replacement plug, gap the plug to manufacturer's specifications and screw plug into cylinder by hand. Torque plug to manufacturer's specifications.
DIRECTIONS TO EVALUATOR:	Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 100 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student removed the spark plug using the correct spark plug socket.	________	________
2. The student correctly determined the plug condition.	________	________
3. Finding the plug in need of replacement the student chose the correct replacement spark plug.	________	________
4. After gapping the plug, the student properly threaded the plug by hand into the cylinder head.	________	________
5. The student torqued the spark plug to manufacturer's specifications.	________	________
6. The student cleaned up the work area.	________	________
7. The student followed all safety procedures.	________	________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 65

TASK: Inspect and reinstall/or replace flywheel.

STANDARD OF PERFORMANCE OF TASK: The flywheel must be aligned as dictated by the key and torqued as specified by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools and safety devices.
2. Read and interpret parts manual.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 45-74.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 56-58.
2. Discuss the characteristics of a defective or damaged flywheel, flywheel key, and crankshaft.
3. Demonstrate the removal, inspection, and replacement of a flywheel and flywheel key.
4. Discuss the importance of replacing a sheared flywheel key and a crankshaft that has a damaged keyway.
5. Have the students demonstrate their ability to inspect and reinstall or replace a flywheel and flywheel key through a teacher directed step-by- step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why must the flywheel nut be torqued to specifications?
2. How does a sheared flywheel key cause ignition failure?
3. What is important to note when inspecting the flywheel?
4. How do you check a flywheel magnet?

Answers:

1. If it is not tightened enough the key will shear.
2. The points open before the magnetic field reaches its maximum intensity, thereby producing a weak current.
3. Note that the key way is not cracked or too wide, that the magnets are clean and strong, and no fins are broken off.
4. Hold a steel object near the magnet. There should be a strong magnetic pull.

PERFORMANCE OBJECTIVE V-TECS 65 (Continued)

PERFORMANCE GUIDE:

1. Remove parts blocking access to flywheel.
2. Pull flywheel off crankshaft.
3. Inspect flywheel for damage (cracks, chips).
4. Inspect flywheel key.
5. Test flywheel magnets.
6. Replace magnets, key and flywheel, and torque to specifications.

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 66

TASK: Replace the point plunger.

STANDARD OF PERFORMANCE OF TASK: The replaced point plunger will open and close the points as specified by the manufacturer, provided all other components functioned as intended.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Proper tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Identify the terminology of magneto ignition systems.
3. Proper use of micrometers and engine service manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 61.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 61.
2. Discuss the characteristics of a worn point plunger.
3. Demonstrate the disassembly of the magneto ignition system and measuring of point plunger.
4. Discuss the importance of installing the point plunger with grooved side out.
5. Demonstrate checking for wear of the point plunger guide with a gage.
6. Discuss the importance of checking the point plunger guide for wear.
7. Have the student demonstrate their ability to replace a point plunger through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. What is the reject size of a Briggs and Stratton point plunger?
2. Is the grooved end of the point plunger installed away from or toward the crankshaft?
3. What happens if a new point plunger is installed in a worn point plunger guide?

Answers:

1. .870".
2. Away from the crankshaft.
3. Oil will leak onto points and cause an ignition failure.

PRACTICAL APPLICATION:
Replace a point plunger so that points open and close as specified by the engine manufacturer.

METHOD OF EVALUATION:
Use Checklist Performance Objective 66 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 66 EVALUATION

PERFORMANCE TEST FOR REPLACING A POINT PLUNGER

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove parts blocking access to point plunger. Remove point plunger and measure plunger with a micrometer. If the plunger does not meet engine manufacturer's specifications, replace plunger, reset points, and reassemble ignition system and engine.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at 100 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly removed parts blocking access to ignition point plunger.	______	______
2. The student removed point plunger and measured plunger accurately.	______	______
3. The student determined if plunger meets manufacturer's specifications and replaced plunger if needed.	______	______
4. The student reset points and reassembled ignition system and engine.	______	______
5. The student checked ignition system for sufficient ignition spark.	______	______
6. The student cleaned up work area.	______	______
7. The student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 67

TASK: Replace points and condenser.

STANDARD OF PERFORMANCE OF TASK: The point gap must be set within .001 inches of manufacturer's specifications and the job should be completed within ten minutes of the flat rate time. The condenser lead and primary lead must be firmly anchored to the terminal post if applicable.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools and equipment.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Identify the terminology of magneto ignition system.
3. Proper use of feeler gauges and parts manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 45-74.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 47-65.
2. Demonstrate the removal of the points and condenser from an engine.
3. Demonstrate positioning of breaker arm on high lobe of breaker cam.
4. Demonstrate proper setting of point gap and reassembly of ignition system.
5. Have the students demonstrate their ability to replace points and condenser through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is a correctly set point gap so important?
2. Why are the points always set on the highest point of the breaker cam?
3. Why must we never let our fingers touch the new breaker points?

Answers:

1. Improperly set points can result in an engine being hard to start, having less than 100 percent power, and backfiring.
2. Because the points wouldn't open at all or very little if they are set with cam in any other position.
3. The oil in our fingers will cause the contacts not to make a good circuit.

PERFORMANCE OBJECTIVE V-TECS 67 (Continued)

PERFORMANCE GUIDE:

1. Remove plug wire.
2. Remove parts blocking access to points and condenser.
3. Inspect magneto plate for wear.
4. Remove points and condenser. Remove condenser and primary lead from points.
5. Install new points and condenser.
6. Rotate crankshaft until point arm is centered on highest lobe of point cam.
7. Set point gap.
8. Replace cover.
9. Run engine.

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 68

TASK: Adjust armature air gap.

STANDARD OF PERFORMANCE OF TASK: The air-gap should be adjusted to within ± .002 of manufacturer's specifications and flywheel must not contact armature.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Identify the terminology of magneto ignition systems.
3. Proper use of service manuals of specification charts.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 69-71.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 69-71.
2. Demonstrate proper setting of armature air gap using manufacturer's specifications and proper gauge.
3. Discuss importance of stator face and magnets being free of rust or dirt.
4. Discuss importance of checking for magneto bearing wear.
5. Have the students demonstrate their ability to adjust the armature air gap through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why must the flywheel nut always be tightened before setting the armature air gap?
2. Why is the proper thickness piece of paper better than a feeler gauge for setting the armature air gap?
3. Why must care be taken when tightening the armature mounting screws?

Answers:

1. If the flywheel is not firmly attached to the crankshaft when setting the air gap, the flywheel can be drawn to the stator plate and thereby give a false clearance gap.
2. It gives a more uniform measurement of the gap by allowing the coil to draw up to the stator laminations.
3. The screws can be easily stripped if overtightened.

PERFORMANCE OBJECTIVE V-TECS 68 (Continued)

PRACTICAL APPLICATION:
Adjust armature air gap to within ± .002" of manufacturer's specifications.

METHOD OF EVALUATION:
Use checklist Performance Objective 68 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 68 EVALUATION

PERFORMANCE TEST FOR ADJUSTING ARMATURE AIR GAP

Student's Name **Date**

DIRECTIONS TO STUDENT:	Remove parts blocking access to armature air gap. Loosen armature screws and insert proper thickness paper between armature and flywheel. Turn flywheel until magnets draw armature to flywheel. Tighten armature screws and remove paper. Reinstall remaining engine parts.
DIRECTIONS TO EVALUATOR:	Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 100 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student removed parts blocking access to armature and flywheel.	______	______
2. The student loosened armature screws and moved armature away from flywheel.	______	______
3. After checking repair specifications, student selected proper thickness paper to set gap.	______	______
4. Student inserted proper thickness paper between flywheel and magnet.	______	______
5. Student rotated flywheel until magnets pull armature to magnets.	______	______
6. Student tightened armature screws and checked engine for proper ignition.	______	______
7. Student reassembled engine.	______	______
8. Student cleaned up work area.	______	______
9. Student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 69

TASK: Test and replace coil.

STANDARD OF PERFORMANCE OF TASK: The decision to replace or not to replace must be the same as that of the instructor. The coil must be replaced such that the spark produced will jump a gap recommended by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools, equipment, and manufacturer's specifications.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Proper use of ignition tester.
3. Proper use of parts manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 71-74.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 71-74.
2. Discuss the use of an ignition tester for testing ignition coils.
3. Demonstrate procedures for checking an ignition coil with the tester.
4. Discuss and demonstrate the importance of hooking up the ignition tester properly.
5. Have the students demonstrate their ability to test an ignition coil through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is it important to check a coil visually for damage before testing with an ignition tester?
2. What does bright blue spark indicate when checking a coil?
3. Why can't you use a coil tester on a metal work bench?

Answers:

1. A chipped insulator may cause a short while testing the coil and result in a shock to the tester.
2. Usually that the primary circuit is alright.
3. The coil could short out to the table and seriously injure the individual testing the coil.

PERFORMANCE GUIDE:

1. Remove parts blocking access to coil.
2. Inspect coil for damage (cracking, evidence of arcing, etc.)
3. Test coil with coil tester.
4. Compare reading with manufacturer's specifications.
5. Reinstall or replace coil.

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 70

TASK: Test and replace ignition wire.

STANDARD OF PERFORMANCE OF TASK: The decision to replace must be the same as that of the instructor. The ignition wire must be replaced so that the spark produced jumps a gap recommended by manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A small gasoline engine and a spark tester.

ENABLING OBJECTIVES:

1. Proper use of hand tools.
2. Proper use of ohmmeter and soldering gun.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 45-74.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 45-74.
2. Discuss the characteristics of a replaceable and non-replaceable ignition wire.
3. Demonstrate the removal of parts to access ignition coil and wire.
4. Demonstrate use of ohmmeter and coil tester to check for a shorted ignition wire.
5. Demonstrate the removal of a spark plug wire from a coil and soldering of a new wire to coil.
6. Demonstrate properly functioning ignition system and reassembly of same.
7. Have the student demonstrate their ability to test and replace an ignition wire through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions;

1. When timing a magnet to the engine the ________ distance is set by adjusting the position of the ________.
2. A condenser that has a capacity too high for a particular engine will cause the (positive or negative) side of the points to pit.
3. When checking a coil for output with a coil tester, why is it important not to fully load the coil with tester for more than a few seconds?

Answers:

1. Edge, stator plate.
2. Positive
3. The primary coil winding could be shorted.

PRACTICAL APPLICATION:
Test and replace ignition wire. The spark produced by ignition system should jump a gap recommended by manufacturer.

METHOD OF EVALUATION:
Use checklist Performance Objective 70 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 70 EVALUATION

PERFORMANCE TEST FOR TESTING AND REPLACING IGNITION WIRE

Student's Name **Date**

DIRECTIONS TO STUDENT: Test and replace an ignition wire, if wire is found defective.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at 100 percent proficiency level.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	The student removed parts blocking access to ignition wires.	________	________
2.	The student visually inspected wires for broken insulation.	________	________
3.	The student properly checked wire continuity with an ohmmeter.	________	________
4.	The student properly chose to replace coil assembly or ignition wire.	________	________
5.	A soldered coil wire was properly removed and new wires were soldered correctly.	________	________
6.	The student reassembled the ignition system properly and checked for spark..	________	________
7.	The student cleaned work area.	________	________
8.	The student followed all safety procedures.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 71

TASK: Time the ignition system on a lawn mower or chain saw engine.

STANDARD OF PERFORMANCE OF TASK: Timing must be set so that the engine delivers full power throughout the rpm range providing all other systems are functioning to manufacturer's specifications.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A small gasoline engine and the necessary tools.

ENABLING OBJECTIVES:
1. Proper use of hand tools and timing light or ohmmeter.
2. Proper use of repair manuals.

RESOURCES:
Turner. **Small Engines, Volume II.** pp. 45-74.

TEACHING ACTIVITIES:
1. Read and discuss text **Small Engines, Volume II,** pp. 45-74.
2. Demonstrate removal of parts blocking access to the ignition system.
3. Demonstrate setting of ignition timing with simple light or ohmmeter.
4. Discuss the importance of properly setting the ignition timing.
5. Have the student demonstrate their ability to time an ignition system through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:
1. Why must the points be set properly before the timing can be set?
2. What results from an improperly timed engine?
3. What purpose does a timing light serve when checking ignition timing?

Answers:
1. When set too close, the points will open too soon and result in an advance in timing; when set too wide, the points will open too late and result in retarded timing.
2. An improperly timed engine will not develop full power or peak rpm.
3. When the light goes out the points have just opened and the engine would have fired at that point. This is the exact point at which the timing marks should be aligned.

PRACTICAL APPLICATION:
Time the ignition system on a lawnmower or chain saw engine so that the engine delivers full power throughout the rpm range.

METHOD OF EVALUATION:
Use checklist Performance Objective 71 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 71 EVALUATION

PERFORMANCE TEST FOR TIMING THE IGNITION SYSTEM ON A MOWER/SAW ENGINE

Student's Name **Date**

DIRECTIONS TO STUDENT: Time the ignition system of a lawn mower or chain saw engine by first setting the armature air gap and the points. Timing should be such that engine delivers full power throughout rpm range.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 100 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The student properly removed parts blocking access to the ignition system.		
2. The student properly set air gap to manufacturer's specifications.		
3. The student properly set point gap to manufacturer's specifications.		
4. The student properly attached an ohmmeter to points and checked point at which points just open.		
5. The student properly measured distance from piston top to top of cylinder wall if required.		
6. The student set stator assembly so points open at proper time and with piston at correct distance from TDC.		
7. The student properly reassembled engine and tested engine.		

CHECKLIST FOR PERFORMANCE OBJECTIVE 71 (Continued)

8. The student cleaned up work area. ________ ________

9. The student followed all safety procedures. ________ ________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 72

TASK: Time the ignition system on outboard engines (above 30 horsepower).

STANDARD OF PERFORMANCE OF TASK: Timing must be within one degree of manufacturer's specifications.

SOURCE OF STANDARD:
Outboard Motor Service Manual, Vol. 2. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
An outboard engine above 30 horsepower and necessary tools.

ENABLING OBJECTIVES:

1. Proper use of hand tools and timing light or ohmmeter.
2. Proper use of repair manuals.

RESOURCE:
Turner. **Small Engines, Volume II.** pp. 45-74.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines, Volume II,** pp. 45-74.
2. Demonstrate timing light hook up and location of timing marks on flywheel.
3. Demonstrate setting of timing with engine idling.
4. Discuss the importance of setting the timing at the degree of advance specified by the manufacturer.
5. Have the students demonstrate their ability to time an outboard engine through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:
Questions:

1. Why must the engine idle speed be checked and set to factory specifications prior to checking ignition timing?
2. What affect does an improperly timed engine have on engine rpm?
3. Why or how does retarded timing result in power loss in an engine?

Answers:

1. The ignition timing changes with rpm increase or increase in idle speed range.
2. It decreases engine rpm.
3. With late timing the piston has already started down in the cylinder, thus reducing the amount of piston travel remaining for the power stroke.

PERFORMANCE GUIDE:

1. Connect one timing light lead to a spark plug and the other to a ground.
2. Find the advance marks on the flywheel.
3. Mark the degree of advance specified by the manufacturer for idle speed.
4. Loosen the distributor jam bolt.
5. With the engine idling, rotate the distributor until the timing mark is aligned with the pointer on the flywheel cover.
6. Tighten jam bolt.
7. Test.

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 73

TASK: Test a diode rectifier.

STANDARD OF PERFORMANCE OF TASK: The decision to replace/reinstall should be the same as that of the instructor. If replaced, current must be changed from AC to DC, depending on the direction of current flow.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and equipment.

ENABLING OBJECTIVES:

1. Proper use of hand tools and ohmmeter.
2. Proper use of service manuals.
3. Proper work techniques in checking electrical systems.

RESOURCES:
Service and Repair Instructions. Briggs and Stratton. pp. 39-40.

TEACHING ACTIVITIES:

1. Read and discuss text **Briggs and Stratton Repair Instructions,** pp. 39-40.
2. Demonstrate proper disconnection of diode wires.
3. Demonstrate the hook up and testing of the diode with an ohmmeter.
4. Discuss the function of the diode in the electrical system checked above.
5. Have the students demonstrate their ability to check a diode rectifier through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:
Questions:

1. What function does a diode rectifier serve in an engine?
2. Why is there no reading on the test meter when checking the rectifier after polarity is reversed?
3. When a diode rectifier goes bad, what will happen to the starting battery?

Answers:

1. It converts AC current to DC current. This allows the battery to charge or lights or other devices to be operated.
2. The diode only permits current to pass through it in one direction.
3. If the engine is started frequently, the battery will go dead quickly.

PRACTICAL APPLICATION:
Test a diode rectifier to determine if unit functions properly. Decision to replace must be same as the instructor's and unit must change current from AC to DC.

METHOD OF EVALUATION:
Use checklist Performance Objective 73 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 73 EVALUATION

PERFORMANCE TEST FOR TESTING A DIODE RECTIFIER

Student's Name **Date**

DIRECTIONS TO STUDENT: Test a diode rectifier to determine if the unit functions properly. Decision to replace must be same as that of instructor.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at 100 percent proficiency level.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	The student properly accessed diode and disconnected same from engine.	______	______
2.	The student properly set ohmmeter.	______	______
3.	The student properly checked diode with ohmmeter.	______	______
4.	The student's decision to replace or use diode is same as instructors.	______	______
5.	The student properly reattached diode to engine and tested same.	______	______
6.	The student properly cleaned up work area.	______	______
7.	The student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING OR REPAIRING THE IGNITION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 75

TASK: Replace safety switch.

STANDARD OF PERFORMANCE OF TASK: The replaced switch will not allow the engine to start until safety hazards involved have been corrected.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and equipment.

ENABLING OBJECTIVES:

1. Proper use of hand tools and ohmmeter.
2. Proper use of service manuals and safety interlock schematics.

RESOURCE:
Crouse, et al., **Small Engine Mechanics,** pp. 198-199.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engine Mechanics,** pages 198-199.
2. Demonstrate ohmmeter use in checking power take-off safety switch and transmission safety switch.
3. Demonstrate ohmmeter use in checking key switch and seat safety switch.
4. Discuss the function and need for each safety switch.
5. Have the students demonstrate their ability to check and replace (if necessary) a safety switch through a teacher guided step-by-step process.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is a safety switch placed on the blade clutch and how does it function?
2. Why is a safety switch necessary on the transmission?
3. When checking the safety interlock system with an ohmmeter, what do you look for?

Answers:

1. To prevent the engine from starting with the blade engaged. When the blade is engaged the circuit to the ignition system is broken (when engine is not running).
2. To prevent the engine from starting with the transmission in gear.
3. An open circuit in any of the interlocks.

PERFORMANCE GUIDE:

1. Remove parts blocking access to switches.
2. Check wires for continuity and shorts visually and with ohmmeter.
3. Check switch using ohmmeter.
4. Replace if found defective.

OVERHAULING SMALL ENGINES

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 76

TASK: Replace a worn or defective piston.

STANDARD OF PERFORMANCE OF TASK: The engine compression should be within 10 percent of that specified by the manufacturer.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
Outboard Motor Service Manual, Vol. 2. Intertec Publishing Corporation.
Small Engines Service Manual. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A set of standard mechanic's tools, a micrometer, ridge reamer, ring expanders and compressors, a cylinder hone and access to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain how to properly use an inside and outside micrometer.
2. Describe how to use a ridge reamer.
3. Identify a ring expander, ring compressor and a cylinder hone.
4. Read and interpret manufacturer's specifications.

RESOURCE:
Roth, **Small Gas Engines,** pp. 171-184.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 171-184.
2. Tell how to prepare the engine so the piston can be removed.
3. Demonstrate the proper procedure for removing the piston from the cylinder.
4. Demonstrate how to remove the piston from the rod.
5. Lecture on the problems involving pistons.
6. Lecture and demonstrate the proper procedure for cross checking a piston and cylinder.
7. Have students evaluate the piston and cylinder to determine their exact condition in a guided learning activity.
8. Have students reassemble the engine in a guided learning activity.

CRITERION REFERENCED MEASURE:
Questions:

1. When checking a piston and cylinder clearance you should:
   a. Cross check the cylinder and piston at the top.
   b. Cross check the cylinder and piston at the bottom.
   c. Both a and b.
   d. None of the above.

2. Scuffing on a piston is:
    a. Normal and should not be a reason to be overly concerned.
    b. Abnormal and is caused by high friction and combustion temperatures approaching the melting temperature of the piston.
3. A four stroke cycle engine piston normally has how many rings?
    a. One.
    b. Two.
    c. Three or more.
    d. They don't have any rings.

Answers:

1. d
2. b
3. c

PERFORMANCE GUIDE:

1. Remove all parts blocking access to piston.
2. Remove cylinder ridge, if any.
3. Remove piston.
4. Clean piston.
5. Inspect for obvious defects or wear.
6. Measure piston lands and skirts using a micrometer.
7. Refer to manufacturer's specifications for reject sizes.
8. Select replacement piston and rings if needed.
9. Remove rod from piston.
10. Install new rings if needed.
11. Hone cylinder if needed.
12. Reinstall rod.
13. Oil cylinder walls.
14. Install piston in cylinder using ring compressor.
15. Replace all parts blocking access to piston.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 77

TASK: Install piston rings.

STANDARD OF PERFORMANCE OF TASK: The rings must be installed so that the compression tests within + 5 percent of the manufacturer's specifications providing valves are not worn, cylinder wall is not scored, or head gasket does not have a compression leak.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
Outboard Motor Service Manual, Vol. 2. Intertec Publishing Corporation.
Small Engines Service Manual. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
Ring expanders and ring groove cleaner.

ENABLING OBJECTIVES:

1. Describe how to use a ring groove cleaner.
2. Describe how to use a ring compressor.
3. Identify and use a ring expander.

RESOURCES:
Roth, **Small Gas Engines,** pp. 171-184.

TEACHING ACTIVITIES:

1. Have students read and discuss **Small Gas Engines,** pp. 171-184.
2. Tell how to prepare the engine so the piston can be removed.
3. Demonstrate how to remove the piston from the engine.
4. Lecture and demonstrate the proper procedure for removing piston rings and the cleaning of ring grooves.
5. Have students remove rings and clean grooves, in a guided learning activity.
6. Demonstrate the proper replacement of piston rings and installing the piston back into the engine.
7. Have students install rings and reinstall piston in the engine in a guided learning activity.

CRITERION REFERENCED MEASURE:

Questions:

1. All of the following are parts of a piston except:
    a. Piston pin.
    b. Pin boss.
    c. Skirt.
    d. Lands.
2. When installing piston rings you always install the rings:
    a. With the bevel to the inside
    b. With the bevel to the outside
    c. It does not make a difference how you install it.
    d. It depends on what the manufacturer recommends.

3. When installing the piston in the engine you should always:
    a. Align the ring ends so they are together.
    b. Stagger the ring ends at 90 degree intervals around the piston.
    c. Stagger the ring ends at 180 degree intervals around the piston.
    d. It depends on what the installer recommends.

Answers:

1. a
2. d
3. b

PRACTICAL APPLICATION:
Install a set of piston rings so that the compression tests within 5 percent of the manufacturer's specifications, providing there are no other obvious defects.

METHOD OF EVALUATION:
Use Checklist Performance Objective 77 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 77 EVALUATION

PERFORMANCE TEST FOR INSTALLING PISTON RINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Install a set of piston rings so that the compression tests within 5 percent of the manufacturer's specifications, providing there are no other obvious defects.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Using a ring expander, removed old rings.	______	______
2. Cleaned piston and ring grooves.	______	______
3. Using a parts catalog, selected new rings.	______	______
4. Using a ring expander, installed rings according to manufacturer's directions.		
a. Installed oil ring and expander.	______	______
b. Installed lower compression ring with ring notch up or down as indicated.	______	______
c. Installed remaining compression rings as in step 4b.	______	______
NOTE: Rings should have been installed according to how the manufacturer recommends.		
5. Followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS SCO2

TASK: Determine wear on internal engine parts using a micrometer and specifications chart.

STANDARD OF PERFORMANCE OF TASK: The wear on internal engine parts should meet manufacturer's specifications, using a telescopic gauge and micrometer, before efficient results can be obtained.

SOURCE OF STANDARD:
Writing Team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Hand tool assortment, engine, service manual, shop towels and rags, clean workbench and cleaning solvent, safety glasses, engine stand.

ENABLING OBJECTIVES:

1. Identify all engine parts.
2. Read a micrometer.
3. Read and interpret a manufacturer's specifications chart.

RESOURCES:
Hires, et al., **Comprehensive Small Engine Repair,** pp. SE 231-D.
Major Overhaul: Internal Parts, (Filmstrip).

TEACHING ACTIVITIES:

1. Show and discuss filmstrip, **Major Overhaul: Internal Parts.**
2. Identify all parts of an engine.
3. Invite a representative from a small engine shop to speak to students.
4. Demonstrate how to overhaul an engine.
5. Have a student demonstrate how to overhaul a small engine.

CRITERION REFERENCED MEASURE:

Questions:

1. Must be cleaned prior to measuring for wear ___________.
    a. Cables
    b. Parts
    c. Pulleys
2. Before removal, the mechanic must mark or stamp ___________.
    a. Cam and crank gear
    b. Connecting rod and cap
    c. Piston
    d. All of these
3. To clean engine parts use _____________.
    a. A cold tank
    b. A solvent tank
    c. A wire wheel

Answers:

1. b
2. b
3. b

PRACTICAL APPLICATION:

Disassemble an engine to determine the wear on the parts by the use of a micrometer and a telescopic gauge.

METHOD OF EVALUATION:

Use of Checklist Performance Objective SCO2 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE SCO2 EVALUATION

PERFORMANCE TEST FOR DETERMINING WEAR ON INTERNAL ENGINE PARTS USING A MICROMETER AND SPECIFICATIONS CHART

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The engine was properly mounted to the engine stand.		
2. The student removed all necessary parts.		
3. The student used correct tools.		
4. The student cleaned all parts.		
5. The student replaced all worn parts.		
6. The student reassembled engine in proper order.		
7. The student ran engine to determine proper operation.		
8. The student cleaned up work area.		
9. The student followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 78

TASK: Replace a cylinder on a 4 cycle engine.

STANDARD OF PERFORMANCE OF TASK: The compression of the engine will be within 5 percent of the manufacturer's specifications.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Inside micrometers, standard small engine mechanics tools and access to manufacturer's specifications.

ENABLING OBJECTIVES:

1. Describe how to use a set of inside micrometers.
2. Use a standard set of small engine mechanics tools.

RESOURCE:
Roth, **Small Gas Engines,** pp. 163-169.
Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 163-169.
2. Demonstrate how to disassemble the engine in order to properly measure the cylinder to determine its condition.
3. Discuss with the students different types of cylinder wear and defects they should look for.
4. In a guided activity, have the students measure the cylinder to determine the size and shape.
5. Have the students compare the measurements they obtained with the manufacturer's specifications.
6. The students will determine if the cylinder will have to be replaced or can be used again.
7. If the cylinder needs to be replaced, it should be replaced in a guided learning activity.

CRITERION REFERENCED MEASURE:

Questions:

1. Cylinder diameter measurements should be:
   a. Checked at the top of the cylinder at 90° intervals.
   b. Checked at the middle of the cylinder at 90° intervals.
   c. Checked at the bottom of the cylinder at 90° intervals.
   d. All of the above.
2. What should be done to a cylinder that is out of round?
   a. Honed
   b. Bored
   c. Deglazed
   d. Nothing, this is normal.

3. The reason(s) for honing a cylinder:
    a. Is to remove slight defects in the cylinder
    b. Is to remove the glaze
    c. Both A and B
    d. Neither A nor B.

Answers:

1. d
2. b
3. c

PERFORMANCE GUIDE:

1. Visually inspect cylinder for obvious defect or wear.
2. Measure cylinder at top, center and bottom using inside micrometer, dial indicator or by using a ring and feeler gauge.
3. Refer to manufacturer's specifications for reject size.
4. Replace cylinder if needed.
   Note: Usually in the case of lawn mower or chain saw engines, the entire block is replaced. However, some outboard engines have replaceable cylinders.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 79

TASK: Ridge ream top of cylinder.

STANDARD OF PERFORMANCE OF TASK: The ridge should be removed so that the reamed portion measures the same as the remainder of the cylinder wall.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A ridge reamer.

ENABLING OBJECTIVES:

1. Identify and use a ridge reamer.
2. Describe how to use a set of inside micrometers.

RESOURCE:
Roth, **Small Gas Engines,** pp. 161-169.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 161-169.
2. Tell students how to remove cylinder head.
3. Explain to students how to properly measure the cylinder to find out how much of a ridge it has.
4. Tell the students why the ridge should be removed.
5. Demonstrate to the students how to properly use a ridge reamer.
6. Have the students cut and measure the cylinder to ensure that only what is necessary is removed.

CRITERION REFERENCED MEASURE:

Questions:

1. Which of the following should be done first before the piston is removed?
    a. Mark the connecting rod.
    b. Remove cylinder ridge.
    c. Mark cylinder number on the piston.
    d. Remove main bearing.
2. If a cylinder ridge is not removed which of the following is likely to happen?
    a. New piston rings will break.
    b. Piston cannot be removed.
    c. Neither a nor b.
    d. Both a and b.
3. A ridge within the cylinder is caused by:
    a. The cylinder wall being worn down.
    b. A build up of carbon at the top of the cylinder.
    c. The cylinder walls getting too hot and becoming distorted.
    d. None of the above, a small engine doesn't get a ridge.

PERFORMANCE OBJECTIVE V-TECS 79 (Continued)

Answers:

1. b
2. d
3. a

PRACTICAL APPLICATION:
Remove the ridge in a cylinder so that it measures within 0.001 of an inch of the rest of the cylinder.

METHOD OF EVALUATION:
Use Checklist Performance Objective 79 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 79 EVALUATION

PERFORMANCE TEST FOR REMOVING A RIDGE OF A CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove the ridge in a cylinder so that it measures the same as the rest of the cylinder.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed reamer in top of cylinder.	______	______
2. Tightened cutter blade against ridge.	______	______
3. Slowly turned reamer in a clockwise direction until ridge cut away.	______	______
4. Measured the cylinder to make sure the ridge had been totally removed.	______	______
Note: Do not tighten reamer excessively -- serious damage will result.		
5. Followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 80

TASK: Replace connecting rods.

STANDARD OF PERFORMANCE OF TASK: The decision made as to replacement should be the same as that of the instructor. The replaced rod will be installed such that bearing clearances are as specified by the manufacturer and bolts are tightened to torque specifications.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
Outboard Motor Service Manual, Vol. 2. Intertec Publishing Corporation.
Small Engines Service Manual. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
Retaining ring pliers, a punch, a hammer, a set of box end wrenches and a "go- no-go" gauge.

ENABLING OBJECTIVES:

1. Identify and use a pair of snap ring pliers.
2. Define a "go-no-go" gauge.

RESOURCE:
Roth, **Small Gas Engines,** pp. 185-188.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 185-188.
2. Students will prepare, through a guided learning activity, a engine so the piston and rod assembly can be removed.
3. Demonstrate to the students how to properly remove a piston and rod assembly making special note to ensure proper marking so it can be reinstalled.
4. Lecture to students on defects encountered with rods and the cause of such defects.
5. Demonstrate to the students how to remove the rod from the piston.
6. Using a proper gauge and manufacturer's specifications, guide the students in an activity to check the connecting rod for service ability.
7. Either using a new or the old rod guide the students through replacing the piston and connecting rod assembly.

CRITERION REFERENCED MEASURE:
Questions;

1. A "go-no-go" gauge:
    a. Tells you when to stop or go.
    b. Is a simple means of finding out if a part has worn too much or is still good.
    c. There is no such gauge.

2. A rod becomes unserviceable if:
    a. It is worn beyond manufacturer's specifications.
    b. If it is bent other than its original shape.
    c. If it has been stretched.
    d. All of the above.
3. The main purpose of the connecting rod is:
    a. Connect the piston to the crankshaft.
    b. Transmit power from the piston to the flywheel.
    c. To ensure the piston stays straight in the cylinder.
    d. To connect the camshaft to the piston.

Answers:

1. b
2. d
3. a

PERFORMANCE GUIDE:

1. Remove piston pin locks, bushings and pins.
2. Remove connecting rod.
3. Visually inspect rod for wear, scoring and warpage. (A go-no-go or plastigauge may be used for checking wear). Warpage may be checked by visually comparing the old rod with a new one or by laying the rod on a flat surface.
4. Replace the rod as it was removed.
5. Replace parts blocking access to connecting rods.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 81

TASK: Replace a crankshaft.

STANDARD OF PERFORMANCE OF TASK: The installed crankshaft will rotate smoothly and be free of loose horizontal or vertical motion. All bearings and journals must be within tolerances specified by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A set of micrometers or dial indicators, a standard set of small engine mechanic tools and the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use a set of micrometers.
2. Explain the use of a dial indicator.

RESOURCES:

Roth, **Small Gas Engines,** pp. 188-193.
Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 188-193.
2. Students will prepare the engine in a guided learning activity so the crankshaft can be removed.
3. Demonstrate to the students how to properly remove the crankshaft.
4. Lecture to the students on the problems that would cause a crankshaft to be rejected and have to be replaced.
5. Demonstrate to the students the proper measurement of the crankshaft journals and bearings.
6. Using the measurements obtained guide the students in determining whether the crankshaft has to be replaced according to manufacturer's specifications.

CRITERION REFERENCED MEASURE:

Questions:

1. When removing the crankshaft:
   a. Be careful not to scratch any bearing surface.
   b. Always use a hammer to help remove it if it is stuck.
   c. It is not necessary to remove the connecting rod first.
   d. None of the above.
2. When measuring the crankshaft:
   a. It is best to measure at several locations around the journal.
   b. It is only necessary to measure one place to determine whether the crank is bad.
   c. It is not necessary to measure the crankshaft if you are going to put it back in the same engine.
   d. You should check both main and rod bearing journals at several intervals.

PERFORMANCE OBJECTIVE V-TECS 81 (Continued)

3. Oil is maintained inside the engine:
    a. By oil seals around the crankshaft and gaskets;
    b. By a very close tolerance of the crankshaft and engine block and gaskets;
    c. By air pressure on the outside of the engine;
    d. By all of the above.

Answers:
1. a
2. d
3. a

PRACTICAL APPLICATION:
Install a crankshaft that will rotate freely and be within tolerances specified by the manufacturer.

METHOD OF EVALUATION:
Use Checklist Performance Objective 81 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 81 EVALUATION

PERFORMANCE TEST FOR REPLACING A CRANKSHAFT

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Install a crankshaft that will rotate freely and be within tolerances specified by the manufacturer.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed all parts which blocked access to crankshaft.	__________	__________
2. Removed the crankshaft.	__________	__________
3. Inspected journals for scoring, bearing deposits and other defects.	__________	__________
4. Measured journals.	__________	__________
5. Referred to manufacturer's specifications for rejection sizes.	__________	__________
6, Correctly determined serviceability of crankshaft.	__________	__________
7. Replaced the crankshaft, if needed.	__________	__________
8. Followed all safety procedures.	__________	__________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 82

TASK: Replace a camshaft.

STANDARD OF PERFORMANCE OF TASK: The camshaft must be replaced so that the gear teeth mesh and timing dots are aligned.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A micrometer, a standard small engine tool kit, and the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Use a standard small engine tool kit.
2. Use a micrometer.
3. Read and interpret the appropriate manufacturer's specifications.

RESOURCE:
Roth, **Small Gas Engines,** pp. 202-204.
Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. In a guided learning activity, students will prepare an engine so the camshaft can be removed.
2. Demonstrate the proper removal of the camshaft.
3. Lecture to students on the problems that occur to a camshaft.
4. Demonstrate to students how to properly check a camshaft using manufacturer's specifications.
5. Guide the students on the proper replacement of the camshaft with emphasis placed on making sure the timing marks are properly aligned.

CRITERION REFERENCED MEASURE:

Questions:

1. A camshaft:
    a. Is a device used to operate valves at a specific time and is driven by the crankshaft gear.
    b. Is a part of the drive and has nothing to do with how the engine runs.
2. The speed of the camshaft is:
    a. The same as the crankshaft
    b. One forth crankshaft speed
    c. Twice the speed of the crankshaft
    d. One half the speed of the crankshaft.
3. The compression release on small engines is located:
    a. On the flywheel
    b. On the camshaft
    c. On the piston
    d. Small engines don't have a compression release.

PERFORMANCE OBJECTIVE V-TECS 82 (Continued)

Answers:

1. a
2. d
3. b

PERFORMANCE GUIDE:

1. Remove all parts blocking access.
2. Visually inspect for obvious defect or wear.
3. Measure wear using a micrometer.
4. Refer to manufacturer's reject tolerances.
5. Replace original or install new camshaft.
   Note: When installing, make sure gear teeth are in mesh and timing dots line up.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 83

TASK: Replace oil seals.

STANDARD OF PERFORMANCE OF TASK: The seal should be replaced in such a manner that the seal is not damaged and oil does not leak from the seal.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A new seal, a seal puller and a seal driver.

ENABLING OBJECTIVES:

1. Identify and use a seal puller.
2. Identify and use a seal driver.
3. Read and interpret a parts catalog.

RESOURCE:
Roth, **Small Gas Engines,** pp. 191-193.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 191-193.
2. Lecture to students on different types of seals.
3. In a guided learning activity have the students prepare the engine so the crankshaft can be removed.
4. Demonstrate to students how to remove the crankshaft seal.
5. Demonstrate the proper installation of the seal and how to install the crankshaft without damage to the seal.

CRITERION REFERENCED MEASURE:

Questions:

1. Oil seals are used to:
    a. Keep oil in the crankcase
    b. Keep dirt out of the engine
    c. Both a and b
    d. None of the above.
2. When installing oil seals:
    a. They should be pressed in.
    b. You should tape the crankshaft to prevent cutting the seal.
    c. You should apply sealant to the outside of the seal.
    d. All of the above.
3. Oil seals are made of:
    a. Rubber
    b. Metal
    c. A combination of a and b
    d. None of the above.

Answers:

1. c
2. d
3. c

PRACTICAL APPLICATION:

Replace the oil seal so as not to have any oil leaking from the seal.

METHOD OF EVALUATION:

Use Checklist Performance Objective 83 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 83 EVALUATION

PERFORMANCE TEST FOR REPLACING OIL SEALS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the oil seal so as not to have any oil leaking from the seal.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed parts blocking access.	______	______
2. Using seal puller, removed seals.	______	______
3. Oiled new seal lightly and installed with seal driver.	______	______
4. Replaced parts removed.	______	______
Note: Seals are easily damaged. Replace with a seal driver.		
5. Followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 84

TASK: Replace valves and valve seats.

STANDARD OF PERFORMANCE OF TASK: The valve seat will be replaced so that after reassembly there will be no compression leakage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Valve spring compressor and lapping compound.

ENABLING OBJECTIVES:

1. Describe and use a valve spring compressor.
2. Describe and use valve seat tools.
3. Identify the proper lapping compound.
4. Describe and use lapping tool.

RESOURCE:
Roth, **Small Gas Engines,** pp. 193-202.
Manufacturer's Specifications.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 193-202.
2. Students will prepare the engine to obtain access to the valves and valve seats in a guided learning activity.
3. Demonstrate how to remove valves from the engine.
4. Demonstrate how to remove valve seats properly.
5. Demonstrate how to properly replace and cut valve seats according to manufacturer's specifications.
6. In a guided learning activity have students replace the valves and obtain the proper clearances.
7. Guide the students in replacing the head and valve chamber cover.

CRITERION REFERENCED MEASURE:

Questions:

1. Valves are used in a gasoline engine:
    a. To allow a fuel and air mixture into the engine;
    b. To allow exhaust gases out of the engine;
    c. Both a and b;
    d. Neither a nor b.
2. Valve seats are normally replaced:
    a. Everytime you go into the engine
    b. Only when worn or damaged beyond repair by refacing
    c. They are never replaced
    d. When they have to be replaced to get proper valve clearance.
3. Proper valve clearance is necessary:
    a. To prevent valves from burning
    b. To maintain proper valve timing
    c. To prevent damage to other engine parts
    d. All of the above.

PERFORMANCE OBJECTIVE V-TECS 84 (Continued)

Answers:
1. c
2. a
3. d

PERFORMANCE GUIDE:
1. Remove cylinder head and valve chamber cover.
2. Remove keepers and valves.
3. Remove old valve seats.
4. Install new seats and recut to face angle specified by manufacturer.
5. Obtain proper valve clearance.
6. Lap valves.
7. Install springs and keepers.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 85

TASK: Grind valves and valve seats.

STANDARD OF PERFORMANCE OF TASK: The valves must be ground to **within** + .001 of the manufacturer's specifications and to the angle and width specified by the manufacturer. Valve seats must be ground to the angle and width specified by the manufacturer. When assembled no pressure leakage occurs.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
Outboard Motor Service Manual, Vol. 2. Intertec Publishing Corporation.
Small Engines Service Manual. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Access to a valve grinding machine and the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Read and interpret manufacturer's specifications for valves.
2. Describe a valve grinding machine.

RESOURCE:
Roth, **Small Gas Engines,** pp. 193-202.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 193-202.
2. Have students remove the valves in the engine in a guided learning activity.
3. Guide the students in cleaning and measuring valves and seats to determine their serviceability.
4. Demonstrate how to grind a set of valves.
5. Demonstrate how to replace valve seats.
6. Demonstrate how to grind valve seats.
7. Guide the students in replacing and reseating valves back into the engine.

CRITERION REFERENCED MEASURE:
Questions:

1. Carbon deposits on valves:
   a. Should be washed off with gasoline
   b. Should be cleaned off with a wire brush
   c. Should not be a concern as it does not affect the valves
   d. Helps the valves to seat properly.
2. When grinding valves:
   a. It is necessary to grind them to a specified angle.
   b. They can be ground to any angle.
   c. Only grind the exhaust valve.
   d. Only grind the intake valve.

3. Valve seats:
    a. Never have to be replaced
    b. Never have to be ground
    c. Are replaced and ground only when needed
    d. Are only in two stroke cycle engines.

Answers:

1. b
2. a
3. c

PRACTICAL APPLICATION:
Replace a set of valve seats so that when checked, there will not be compression leakage.

METHOD OF EVALUATION:
Use Checklist Performance Objective 85 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 85 EVALUATION

PERFORMANCE TEST FOR REPLACING VALVES AND VALVE SEATS

Student's Name **Date**

DIRECTIONS TO STUDENT: Remove and replace a set of valve seats and valves so that when checked there will be no compression leakage.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Removed cylinder head and valve chamber cover.		
2. Removed keepers and valves.		
3. Removed old valve seats.		
4. Installed new seats and recut to face angle specified by manufacturer.		
5. Obtained proper valve clearance.		
6. Lapped valves.		
7. Installed springs and keepers.		
8. Followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 86

TASK: Lap valves.

STANDARD OF PERFORMANCE OF TASK: There can be no compression leakage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A valve lapping tool and valve lapping compound.

ENABLING OBJECTIVES:

1. Identify and use a valve lapping tool.
2. Describe two types of lapping compound.

RESOURCE:
Roth, **Small Gas Engines,** pp. 193-204.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 193-204.
2. In a guided learning activity have students prepare an engine so the valves can be removed.
3. Demonstrate how to properly remove the valves from the engine.
4. Guide the students through measuring the valves, seats and valve guides to determine their serviceability.
5. Demonstrate to the students how to properly lap a set of valves.
6. Guide students through obtaining proper valve clearance and replacing parts removed for valve access.

CRITERION REFERENCED MEASURE:

Questions:

1. Reason(s) for lapping valves:
   a. Replacing old valves
   b. Replacing old seats
   c. Valve seats have been reconditioned
   d. All of the above.
2. A valve margin should not be smaller than:
   a. 1/32 in.
   b. 1/64 in.
   c. 1/16 in.
   d. 1/8 in.
3. When cutting valves and valve seats they should be cut:
   a. At least one degree difference between the two;
   b. The same to ensure a proper fit;
   c. At least ten degrees difference to ensure a narrow contact area;
   d. You don't cut them.

PERFORMANCE OBJECTIVE V-TECS 86 (Continued)

Answers:

1. d
2. b
3. a

PRACTICAL APPLICATION:
Lap a set of valves so there are no compression leaks.

METHOD OF EVALUATION:
Use Checklist Performance Objective 86 to determine if the assignment was completed with 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 86 EVALUATION

PERFORMANCE TEST FOR LAPPING VALVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Lap a set of valves so there are no compression leaks.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 100 percent proficiency level.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Positioned piston on compression stroke.	____	____
2. Obtained proper valve stem clearance.	____	____
3. Coated valve face with compound.	____	____
4. Using lapping tool, rotated valve against valve seat until properly seated.	____	____
5. Checked stem clearance.	____	____
Note: All compound must have been removed from engine before reassembling.		
6. Followed all safety rules.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 87

TASK: Replace damaged thread using helicoil.

STANDARD OF PERFORMANCE OF TASK: The replaced thread must hold when the bolt is tightened to its torque standards.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A drill and drill bits and a helicoil kit.

ENABLING OBJECTIVES:

1. Describe a helicoil kit.
2. Identify the appropriate drill bits.

RESOURCE:
Roth. **Small Gas Engines.**

TEACHING ACTIVITIES:

1. Lecture to students on why you would use a helicoil.
2. List the advantages and disadvantages of a helicoil.
3. Demonstrate how to remove the damaged threads using the proper drill bit.
4. Demonstrate how to tap the new threads and install the helicoil.
5. In a guided learning activity have the students replace the part or bolt and torque into place.

CRITERION REFERENCED MEASURE:
Questions:

1. What is a helicoil?
    a. A way of replacing threads on bolts.
    b. A way of replacing threads in holes.
    c. A type of spring.
    d. A type of helicopter.
2. When preparing to use a helicoil:
    a. It is only necessary to remove the damage portion of the threads;
    b. It is not necessary to remove the threads, only install the helicoil;
    c. All of the threads must be removed before installing the helicoil;
    d. The threads must be removed and new threads cut in before installing the helicoil.
3. When cutting threads for a helicoil you have to use:
    a. The same size tap as the size of the bolt
    b. The correct tap for the size of helicoil
    c. The correct die for the size of helicoil
    d. The same size die as the size of bolt.

PERFORMANCE OBJECTIVE V-TECS 87 (Continued)

Answers:

1. b
2. d
3. b

PERFORMANCE GUIDE:

1. Select drill bit for reaming out old thread. (Refer to helicoil standards).
2. Ream out old thread.
3. Clean reamed hole.
4. Tap hole with helicoil tap.
5. Install helicoil.

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 88

TASK: Repair damaged thread using a tap and die set.

STANDARD OF PERFORMANCE OF TASK: The internal and external threads will hold the torque specifications for a bolt or tap of that size.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A tap and die set.

ENABLING OBJECTIVES:

1. Identify and die a tap and die set.
2. Read and interpret torque specifications.

RESOURCE:
Roth. **Small Gas Engines.**

TEACHING ACTIVITIES:

1. Lecture to students on the reasons why one would have to repair threads.
2. Discuss the difference between internal and external threads.
3. Demonstrate to the students how to determine the actual size of the threaded object.
4. Discuss the difference between course and fine threads.
5. Demonstrate, using a tap and die set, how to properly repair a set of threads.

CRITERION REFERENCED MEASURE:

Questions:

1. All tap and dies are:
   a. Fine thread
   b. Course thread
   c. Either fine or course
   d. None of the above.
2. Taps are used for threads:
   a. In holes
   b. On bolts
   c. Both a and b
   d. None of the above.
3. Dies are used for threads:
   a. In holes
   b. On bolts
   c. Both a and b
   d. None of the above.

Answers:
1. c
2. a
3. b

PRACTICAL APPLICATION:
Using a part supplied by the instructor, repair the damaged threads using a tap and die set.

METHOD OF EVALUATION:
Use checklist Performance Objective 88 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 88 EVALUATION

PERFORMANCE TEST FOR REPAIRING DAMAGED THREAD USING A TAP AND DIE SET

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Using a part supplied by the instructor, repair the damaged threads using a tap and die set.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. If replacing internal thread:		
a. Selected the correct tap.	______	______
b. Inserted the tap into a tap handle.	______	______
c. Oiled the tap, inserted the tap into the receptacle and turned in a clockwise direction.	______	______
d. Added oil as needed.	______	______
2. If repairing external thread:		
a. Selected die and inserted in die stock.	______	______
b. Adjusted die if needed.	______	______
c. Prepared bolt for threading.	______	______
d. Turned stock in clockwise direction while applying light pressure and oiling frequently.	______	______
3. Followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 89

TASK: Deglaze cylinder.

STANDARD OF PERFORMANCE OF TASK: The cylinder walls will exhibit a cross hatched pattern as illustrated in manufacturer's manual.

SOURCE OF STANDARD:
Air Cooled Engine Mechanics Training Manual. Engine Service Association, pp. 152.

CONDITIONS FOR PERFORMANCE OF TASK:
A cylinder hone, carborundum brush or glaze breaker, and an electric drill.

ENABLING OBJECTIVES:

1. Identify a cylinder hone, carborundum brush, or a glaze breaker.
2. Identify the appropriate drill.

RESOURCE:
Roth. **Small Gas Engines,** pp. 168-169.

TEACHING ACTIVITIES:

1. Have students read and discuss text **Small Gas Engines,** pp. 168-169.
2. Lecture to students on the reasons why it is necessary to have a cylinder.
3. In a guided learning activity, have the students prepare the engine to be honed.
4. Demonstrate how to properly hone a cylinder paying close attention to the pattern left by the hone.
5. In a guided learning activity allow students to hone a cylinder.

CRITERION REFERENCED MEASURE:
Questions:

1. You deglaze a cylinder to:
    a. Assure the rings and the cylinder wear at the same rate;
    b. Assure the cylinder wears faster than the rings;
    c. Assure the rings wear faster than the cylinder;
    d. None of the above.
2. You use a ___________ to deglaze a cylinder.
    a. Boring bar
    b. Cylinder hone
    c. Sandpaper
    d. File.
3. The proper pattern that is desired after honing can be obtained by:
    a. Reversing the drill at different times;
    b. Moving the drill up and down while rotating;
    c. It can't be obtained with a drill;
    d. It can only be obtained from the factory.

PERFORMANCE OBJECTIVE V-TECS 89 (Continued)

Answers:

1. a
2. b
3. b

PRACTICAL APPLICATION:

Given a cylinder, deglaze the cylinder so it will exhibit a cross hatched pattern as illustrated by the manufacturer.

METHOD OF EVALUATION:

Use checklist Performance Objective 89 to determine if the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 89 EVALUATION

PERFORMANCE TEST FOR DEGLAZING A CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a cylinder, deglaze the cylinder so it will exhibit a cross hatched pattern as illustrated by the manufacturer.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed hone in drill.	________	________
2. Oiled cylinder wall with light oil.	________	________
3. Inserted hone in cylinder and tightened snugly against wall.	________	________
4. Started drill and moved hone rapidly up and down in cylinder for about 15 seconds.	________	________
5. Removed hone and cleaned cylinder thoroughly.	________	________
6. Followed all safety procedures.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: OVERHAULING SMALL ENGINES

PERFORMANCE OBJECTIVE V-TECS 90

TASK: Install a short block.

STANDARD OF PERFORMANCE OF TASK: The short block will be installed in such a manner that all external components function and the engine operates at the specified rpm and delivers the horsepower as intended by the manufacturer as measured by a dynamometer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A standard set of tools used by small engine mechanics.

ENABLING OBJECTIVES:

1. Identify and use a standard set of tools for a small engine mechanic.
2. Describe a dynamometer.

RESOURCES:
Roth. **Small Gas Engines.**

TEACHING ACTIVITIES:

1. Lecture to students on problems that would be a cause to replace the short block of an engine.
2. In a guided learning activity, have the students prepare (strip) the engine block.
3. In a guided learning activity, demonstrate to students how to evaluate the condition and determine the cause of that condition.
4. Discuss with students factors that contributed to or caused the damage to the engine block.
5. Demonstrate to the students how to prepare a block so the old parts can be reinstalled.
6. Have the students replace all necessary parts in a guided learning activity.

CRITERION REFERENCED MEASURE:
Questions:

1. Which of the following would be a cause to replace an engine block.
   a. A crack in the cylinder.
   b. A hole in the crankcase.
   c. All the cooling fins broken off.
   d. All of the above.
2. When replacing a short block you should:
   a. Check everything as if you were rebuilding your old engine.
   b. Prepare the new block as you would the old block.
   c. Neither a or b.
   d. Both a and b.

PERFORMANCE OBJECTIVE V-TECS 90 (Continued)

3. A short block consists of:
    a. Everything except the head
    b. Everything except the head, carburetor, and exhaust
    c. Block, piston and rod, cam, lifters, valves, and crankshaft
    d. None of the above.

Answers:
1. d
2. d
3. c

PERFORMANCE GUIDE:
1. Remove carburetors.
2. Remove blower housing.
3. Remove fly wheel.
4. Remove the armature-governor assembly.
5. Remove the muffler.
6. Remove blade clutch or pulley from crankshaft.
7. Install all parts removed on new short block.

SERVICING AND MAINTAINING LAWNMOWER ASSEMBLIES

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 91

TASK: Adjust clutch control rod.

STANDARD OF PERFORMANCE OF TASK: The clutch will completely engage and disengage as needed.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A tape or rule, snap ring pliers and manufacturer's manual.

ENABLING OBJECTIVES:

1. Use a rule or tape measure.
2. Identify a set of snap ring pliers.

RESOURCE:
Billet. **Small Engines and Power Transmission Systems,** pp. 171-185.

TEACHING ACTIVITIES:

1. Lecture to students on the function of the clutch.
2. Demonstrate how to properly check a clutch rod to see if it is within factory specifications.
3. Discuss the results of a maladjusted clutch rod.
4. Demonstrate how to properly adjust a clutch control rod.
5. In a guided learning activity, have the students make the proper adjustments to the clutch control rod.

CRITERION REFERENCED MEASURE:

Questions:

1. If the clutch rod is not adjusted properly:
    a. It could cause abnormal wear of the clutch;
    b. It could cause the mower to creep;
    c. It could make it hard to shift the gears;
    d. All of the above.
2. The clutch rod is used to:
    a. Transmit force from the clutch pedal to the clutch assembly;
    b. Pull and engage or disengage the clutch;
    c. Line the clutch up when putting it in gear.
3. When adjusting the clutch rod you should have:
    a. The engine off
    b. The spark plug wire disconnected
    c. The transmission lever in neutral
    d. All of the above.

PERFORMANCE OBJECTIVE V-TECS 91 (Continued)

Answers:

1. d
2. a
3. d

PRACTICAL APPLICATION:

Adjust the clutch rod so it will engage and disengage completely as needed.

METHOD OF EVALUATION:

Use Checklist Performance Objective 91 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 91 EVALUATION

PERFORMANCE TEST FOR ADJUSTING A CLUTCH CONTROL ROD

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust the clutch control rod so the clutch will completely engage and disengage as needed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work would be completed in a reasonable time limit with a 90 percent proficiency level.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked clutch control rod for proper travel.		
2.	Loosened jam nuts.		
3.	Adjusted jam nut to provide rod with proper travel.		
4.	Tightened jam nut.		
5.	Checked to determine if the clutch is engaging and disengaging as required.		
6.	Observed all safety rules.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 92

TASK: Adjust height of cut.

STANDARD OF PERFORMANCE OF TASK: The cutting height must be within 1/2" of that requested by the instructor.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Necessary tools and equipment.

ENABLING OBJECTIVES:
1. Identify and use a set of small engine mechanic's tools.
2. Read and interpret the appropriate owner's manual.

RESOURCE:
Billet. **Small Gas Engines and Power Transmission Systems.**

TEACHING ACTIVITIES:
1. Discuss the reasons for varying the height of cut on a mower.
2. Discuss the different types of height adjusters.
3. Demonstrate how to properly check the cutting height of the blade.
4. Demonstrate the proper procedure for adjusting the height of a cutting blade.
5. In a guided learning activity, have the students make the necessary adjustments to obtain the desired height.

CRITERION REFERENCED MEASURE:
Questions:
1. When adjusting the height of the cutting blade:
   a. You have to shim the blade.
   b. You have to shim the engine.
   c. You have to adjust the mower deck.
   d. None of the above.
2. When adjusting the height of the mower:
   a. The mower should not be running.
   b. The mower should not be turned over.
   c. The mower deck should be level before and after adjusting.
   d. All of the above.
3. When adjusting the height of the mower deck:
   a. Moving the wheels up will lower the blade.
   b. Moving the wheels down will lower the blade.

Answers:
1. c
2. d
3. a

PERFORMANCE OBJECTIVE V-TECS 92 (Continued)

PERFORMANCE GUIDE:

1. Disconnect spark plug wire.
2. Measure blade height.
3. Set wheel adjusters to proper height.
4. Reposition wheel bolts.
5. Install blade clutch of proper length.
6. Reconnect spark plug wire.

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 93

TASK: Grind and balance rotary blade.

STANDARD OF PERFORMANCE OF TASK: The sharpened blade should be ground to an angle between 28 and 32°.

SOURCE OF STANDARD:
Foley Manufacturing Company, Operating and Maintaining Manual Foley Rotary Blade Grinder -- Balancer -- Model 398, as cited in a catalog of Performance Objectives, Criterion-Referenced Measures and Performance Guide for Gardening -- Grounds Keeping, Atlanta, Georgia Vocational -- Technical Consortium of Southern States, pp. 159.

CONDITIONS FOR PERFORMANCE OF TASK:
Standard tools, grinder and manufacturer's specifications.

ENABLING OBJECTIVES:

1. Identify and use a standard set of small engine mechanic's tools.
2. Describe a grinder.
3. Read and interpret manufacturer's specifications.

RESOURCES;

Comprehensive Small Engine Repair, pp. 171-185.

TEACHING ACTIVITIES:

1. Read and discuss text **Comprehensive Small Engine Repair,** pp. 171-185.
2. Instruct students on safety precautions to be observed while sharpening blades.
3. In a guided learning activity have the students prepare the mower so the blade can be removed to be sharpened.
4. Demonstrate how to properly sharpen the blade so as not to cause the blade to be out of balance.
5. Guide the students in replacing the blade emphasizing safety at all times.

CRITERION REFERENCED MEASURE:

Questions:

1. When sharpening a blade it is best to:
    - a. Turn the mower over and sharpen it;
    - b. Remove the blade and then sharpen and balance it;
    - c. Sharpen it. It is not necessary to balance a rotary blade.
2. When sharpening a blade the best angle is:
    - a. 10-15 degrees.
    - b. 30-35 degrees.
    - c. 28-32 degrees.
    - d. 43-45 degrees.
3. Sharpening a blade properly helps to:
    - a. Maintain proper balance
    - b. Reduce wear on the engine
    - c. Maintain a level cut
    - d. All of the above.

Answers:
1. b
2. c
3. d

PRACTICAL APPLICATION:
Sharpen a mower blade so the finished blade angle is between 28 and 32 degrees.

METHOD OF EVALUATION:
Use checklist Performance Objective 93 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 93 EVALUATION

PERFORMANCE TEST FOR GRINDING AND BALANCING A ROTARY BLADE

Student's Name **Date**

DIRECTIONS TO STUDENT:	Grind and balance a rotary blade so the finished angle is between 28 and 32 degrees and the blade is still in balance.
DIRECTIONS TO EVALUATOR:	Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit with a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed spark plug wire.		
2. Removed blade belt. (If so equipped)		
3. Removed blade.		
4. Sharpened blade to 28-32° angle.		
5. Ground down heavy side of blade if needed.		
6. Checked blade balance.		
7. Replaced blade.		
8. Replaced spark plug wire and run mower for safety check.		
9. Observed all safety rules.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 94

TASK: Lubricate a mower.

STANDARD OF PERFORMANCE OF TASK: All points specified by the manufacturer must be greased or oiled. Moving parts must work freely.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A grease gun, rags and manufacturer's manual.

ENABLING OBJECTIVES:

1. Use a grease gun.
2. Read and interpret the appropriate manufacturer's manual for the mower to be used.

RESOURCE:
Manufacturer's Manual

TEACHING ACTIVITIES:

1. Discuss with the students the proper intervals for which the mower should be greased.
2. Show and identify the different types of grease fittings that may be found on a lawn mower.
3. Discuss the different types of greases and why you would use them.
4. Demonstrate the proper way you should put grease in a fitting.
5. In a guided learning activity, have the students grease the mower at points described by the manufacturer.

CRITERION REFERENCED MEASURE:

Questions:

1. When greasing a mower you should use the grease specified by the manufacturer.
    a. Always
    b. Only when it is convenient
    c. If possible and cheap enough
    d. Just any grease will do.
2. Grease is made of what type of base material:
    a. Mineral
    b. Vegetable
    c. Synthetic
    d. All of the above.
3. When greasing the mower you should watch for:
    a. Too much grease
    b. Fittings that will not take grease
    c. The wrong type of grease
    d. All of the above.

PERFORMANCE OBJECTIVE V-TECS 94 (Continued)

Answers:

1. a
2. d
3. d

PERFORMANCE GUIDE:

1. Identify lubrication points using a manufacturer's chart.
2. Select a recommended lubricant.
3. Clean fittings.
4. Fill fittings with grease using a grease gun.
5. Remove excess grease.
6. Oil parts as needed.

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 95

TASK: Replace drive cogs on self-propelled walk-behind lawn mower.

STANDARD OF PERFORMANCE OF TASK: The drive cogs must be replaced such that they engage the wheel and propel the lawn mower without excessive slippage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A standard tool kit and self-propelled walk-behind lawn mower.

ENABLING OBJECTIVES:

1. Identify and use a standard set of small engine mechanics tools.
2. Identify a self-propelled lawn mower.

RESOURCE:
Manufacturer's Manual.

TEACHING ACTIVITIES:

1. Describe the drive action that takes place with a self-propelled mower.
2. Discuss the problems that occur to the drive components.
3. Demonstrate to the students how to remove the drive cogs and inspect the drive parts for any defects.
4. In a guided learning activity, have the students remove and replace the drive cogs on a self-propelled mower.
5. Have the students test the mower to see if it works as specified by the manufacturer.

CRITERION REFERENCED MEASURE:
Questions:

1. Which of the following would be a reason to replace a drive cog on a self-propelled mower.
    a. Drive gear smooth.
    b. Gear cracked.
    c. Shaft bushing worn.
    d. All of the above.
2. When replacing the drive cog:
    a. You should also check the remaining drive parts.
    b. It may be necessary to adjust the disengage mechanism.
    c. Both a and b.
    d. Neither a nor b.
3. Slack on the chain on the drive should not exceed:
    a. 1/2 inch.
    b. 1/4 inch.
    c. 3/8 inch.
    d. You should not have any.

Answers:

1. d
2. c
3. a

PRACTICAL APPLICATION:
Replace the drive cogs so that they engage the wheels and propel the lawn mower without excessive slippage.

METHOD OF EVALUATION:
Use Checklist Performance Objective 95 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 95 EVALUATION

PERFORMANCE TEST FOR REPLACING DRIVE COGS ON A SELF-PROPELLED WALK-BEHIND LAWN MOWER

Student's Name ________________ **Date** ________

DIRECTIONS TO STUDENT: Replace the drive cogs on a self-propelled walk-behind lawn mower such that they engage the wheels and propel the mower without excessive slippage.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit at a 90 percent proficiency level.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed mower drive unit.	________	________
2. Inspected pulleys.	________	________
3. Inspected drive shafts.	________	________
4. Inspected bearings.	________	________
5. Inspected drive gears.	________	________
6. Inspected gear seal.	________	________
7. Replaced defective parts.	________	________
8. Reassembled unit.	________	________
9. Checked for correct operation.	________	________
10. Observed all safety rules.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature ________________ **Date** ________

DUTY: SERVICING AND MAINTAINING LAWNMOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS SC03

TASK: Tighten bolts.

STANDARD OF PERFORMANCE OF TASK: Lawnmower must meet manufacturer's specifications in order to perform.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Handtool assortment, manufacturer's service manual, air hose, new head gasket, clean work area, solvent tank, wooden scraper, clean rags.

ENABLING OBJECTIVES:

1. Read and interpret manufacturer's specification chart.
2. Read a torque wrench.
3. Identify all parts of a lawnmower.

RESOURCE:

Mechanics Handbook, Lawn-Boy, Chapter I.
Automotive Mechanics Teacher's Manual, Figure 221.

TEACHING ACTIVITIES:

1. Discuss the placement of bolts on different types of engines.
2. Demonstrate the proper use of a torque wrench.
3. Have student demonstrate the use of a torque wrench.
4. Demonstrate how to remove bolts from engine.
5. Demonstrate how to torque the cylinder bolts.
6. Have student remove bolts and then tighten on an engine.

CRITERION REFERENCED MEASURE:

Questions:

1. All __________ must be properly tightened in order for the engine to perform correctly.
2. Incorrect torque on the head will cause the __________ __________ to blow.
3. A __________ __________ is used to tighten bolts to meet manufacturer's specifications on an engine.

Answers:

1. Bolts
2. Head gasket
3. Torque wrench

PERFORMANCE GUIDE:

1. Place engine upon workbench.
2. Remove cylinder head bolts.
3. Remove cylinder baffle and spark plugs.
4. Clean fins.
5. Remove cylinder head from engine.
6. Make a diagram of bolts when being removed.
7. Clean carbon build up, using a wooden scraper from cylinder head, piston and valves.
8. Wipe cylinder head, piston and valves with solvent on rag.
9. Wipe rag.
10. Place cylinder gasket on top of cylinder. (Must be in proper position).
11. Place cylinder gasket on top of gasket. (Between cylinder and cylinder head).

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 96

TASK: Repair steering assembly on riding lawn mowers.

STANDARD OF PERFORMANCE OF TASK: The repaired steering assembly must operate smoothly. Steering must be free of binding and sticking and operate with little effort.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and manufacturer's manual.

ENABLING OBJECTIVES:

1. Identify and use small engine mechanics tools.
2. Read and interpret the appropriate manufacturer's manual.

RESOURCE:
Billet. **Small Gas Engines and Power Transmission Systems,** pp. 197-201.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Gas Engines and Power Transmission Systems,** pp. 197-201.
2. Discuss the different types of steering systems installed in tractors today.
3. Lecture to students on the problems that plague steering systems and how to prevent them.
4. Demonstrate how to inspect a steering system to determine whether or not the system is functioning as it should.
5. In a guided learning activity, have the students check all steering system components to determine their serviceability in accordance with manufacturer's specifications.

CRITERION REFERENCE MEASURE:

Questions:

1. What is a tie rod?
    a. A rod used to connect two steering components.
    b. A rod that has been tied up.
    c. A rod that you use to tie the wheel on with.
    d. There is no such rod.
2. Lawn mowers use which of the following type(s) of steering mechanisms:
    a. Rack and pinion
    b. Tiller
    c. Worm gear
    d. All of the above.
3. The most common cause of excessive wear on steering systems in lawn mowers:
    a. Rough terrain
    b. Improper lubrication
    c. Cheap metals
    d. All of the above.

PERFORMANCE OBJECTIVE V-TECS 96 (Continued)

Answers:
1. a
2. d
3. b

PERFORMANCE GUIDE:
1. Remove hood.
2. Replace tie rods if needed.
3. Replace spindles if needed.
4. Replace gears if needed.
5. Replace steering rod if needed.
6. Replace bushing if needed.
7. Check for safe and correct operation.
8. Replace hood.

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 97

TASK: Set up an oxyacetylene welder.

STANDARD OF PERFORMANCE OF TASK: The welder must be set up such that all items on checklist are performed.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Oxyacetylene welder supplies and components.

ENABLING OBJECTIVES:

1. Identify oxyacetylene welder.
2. Describe the supplies needed.

RESOURCE:
Althouse, et al., **Modern Welding,** pp. 1-1 -- 1-34.

TEACHING ACTIVITIES:

1. Read and discuss text **Modern Welding,** pp. 1-1 -- 1-34.
2. Lecture to the students on the dangers of using this equipment.
3. Demonstrate to the students how to properly set up the oxygen and acetylene tanks.
4. Demonstrate to the students how to properly connect and adjust the regulators on both tanks.
5. In a guided learning activity, have the students set up the oxycetylene welding equipment.

CRITERION REFERENCE MEASURE:
Questions:

1. What is the maximum amount at which the acetylene tank should be opened?
    a. 1/2 turn.
    b. 3/8 turn.
    c. 3/4 turn.
    d. 1/4 turn.
2. What is the maximum pressure rating on the acetylene regulator low pressure side?
    a. 10 PSI.
    b. 15 PSI.
    c. 20 PSI.
    d. 60 PSI.
3. Burning acetylene is what color?
    a. Red
    b. Blue
    c. Yellow
    d. Colorless

Answers:

1. d
2. b
3. c

PRACTICAL EVALUATION:
Set up an oxyacetylene welder so that all items on the checklist are performed.

METHOD OF EVALUATION:
Use checklist Performance Objective 97 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 97 EVALUATION

PERFORMANCE TEST FOR SETTING UP AN OXYACETYLENE WELDER

Student's Name **Date**

DIRECTIONS TO STUDENT: Set up the welder in accordance with all items on the checklist.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit with 90 percent accuracy.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Secured oxygen and acetylene cylinder to cart.		
2.	Removed safety caps from cylinder and blew dust from valves.		
3.	Installed oxygen and acetylene regulators.		
4.	Installed lines and checked with soapy water.		
5.	Installed mixer and made sure mixer valve was closed.		
6.	Installed welding tip.		
7.	Released tension from the oxygen regulator.		
8.	Slowly opened oxygen tank (fully).		
9.	Released tension on acetylene regulator.		
10.	Opened acetylene valve 1/4 turn.		
11.	Observed all safety rules.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 98

TASK: Welding a broken metal frame or handle using oxyacetylene.

STANDARD OF PERFORMANCE OF TASK: The repaired frame or handle will hold as well as the original.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Oxyacetylene welding equipment and a selection of rods and fluxes.

ENABLING OBJECTIVES:

1. Identify an oxyacetylene welding outfit.
2. Describe the different types of welding rods used with oxyacetylene welding.

RESOURCE:
Althouse, et al., **Modern Welding,** pp. 1-1 -- 1-34.

TEACHING ACTIVITIES:

1. Discuss with the students the different types of metal that can be welded using an oxyacetylene welder.
2. Demonstrate the methods used to determine what type of metal a part is made of.
3. In a guided learning activity, have the students set up the oxyacetylene welder to be used.
4. Demonstrate the proper way to weld the metal of the handle to be welded.
5. In a guided learning activity, have the students weld a handle.

CRITERION REFERENCE MEASURE:

Questions:

1. What is the maximum low pressure setting on the acetylene gage?
    a. 10 PSI.
    b. 5 PSI.
    c. 15 PSI.
    d. 25 PSI.
2. What type of rod could be used on a steel handle?
    a. Brass
    b. Copper coated steel
    c. Both a and b
    d. Neither a nor b.
3. When using a brass welding rod:
    a. It is necessary to use a flux.
    b. It is unnecessary to use a flux.
    c. A certified welder is the only one that uses flux.
    d. The flux is always on the rod.

PERFORMANCE OBJECTIVE V-TECS 98 (Continued)

Answers:

1. c
2. c
3. a

PERFORMANCE GUIDE:

1. Determine the type of metal to be welded.
2. Prepare the metal to be welded.
3. Select an appropriate welding process (fusion or brazing).
4. Select an appropriate rod.
5. Select appropriate flux.
6. Cut tanks on.
7. Light the gas mixture.
8. Adjust the flame (acetylene, oxygen or neutral).
9. Weld the broken frame or handle.

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 99

TASK: Welding a broken metal frame or handle using an electric welder.

STANDARD OF PERFORMANCE OF TASK: The welded frame or handle must hold as well as the original.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
An electric welder, access to a rod selection chart, and a selection of rods.

ENABLING OBJECTIVES:

1. Identify an electric welder.
2. Describe the different types of welding rods used with an electric welder.

RESOURCE:
Althouse, et al., **Modern Welding,** pp. 7-1 -- 7-16.

TEACHING ACTIVITIES:

1. Read and discuss text **Modern Welding,** pp. 7-1 -- 7-16.
2. Lecture to the students on the types of metal that can be welded with an electric welder.
3. Demonstrate to the students how to determine what type of metal the part to be welded is made of.
4. Demonstrate how to properly weld with an electric welder.
5. In a guided learning activity, have the students weld using an electric welder.

CRITERION REFERENCED MEASURE:

Questions:

1. When using an electric welder, what is the most hazardous thing you have to watch out for?
    a. Dropping the machine on you
    b. The welder burning up
    c. Electric shock
    d. Burning the metal up.
2. The two main types of electric welders are:
    a. AC and DC
    b. AC and AB
    c. DC and DB
    d. AD and DB.
3. At what angle should you hold the rod when welding?
    a. 10 degrees
    b. 15 degrees
    c. 20 degrees
    d. 45 degrees.

Answers:
1. c
2. a
3. c

PRACTICAL APPLICATION:
Weld a broken frame or handle so that it holds as well as the original.

METHOD OF EVALUATION:
Use Checklist Performance Objective 99 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 99 EVALUATION

PERFORMANCE TEST FOR WELDING A BROKEN FRAME OR HANDLE

Student's Name **Date**

DIRECTIONS TO STUDENT: Weld a frame or handle so it holds as well as the original.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit with at least 90 percent accuracy.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Determined the type of metal to be welded.	______	______
2. Prepared the metal to be welded.	______	______
3. Selected an appropriate type of welding rod.	______	______
4. Selected an appropriate heat range.	______	______
5. Welded the broken frame or handle.	______	______
6. Observed all safety rules.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 100

TASK: Replace belts.

STANDARD OF PERFORMANCE OF TASK: The belt(s) must be replaced such that they perform the function intended without slippage and without applying excessive pressure to the bearings or pulleys involved.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and manufacturer's guide.

ENABLING OBJECTIVES:

1. Identify use of small engine tools.
2. Read and interpret appropriate manufacturer's repair manual.

RESOURCE:
Billet. **Small Engines and Power Transmission Systems,** pp. 173-185.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Engines and Power Transmission Systems,** pp. 173-185.
2. Lecture to students on the different types of belts and their uses.
3. Discuss the difficulties encountered with using belts in drive lines.
4. Demonstrate how to properly replace the belts on a selected mower.
5. In a guided learning activity have the students replace the belts on a given mower.

CRITERION REFERENCED MEASURE:

Questions:

1. Which of the following is a defect of a drive belt?
    a. Cracked
    b. Oil-soaked
    c. Glazed
    d. Torn and split
    e. All of the above.
2. A belt when properly adjusted must not deflect more than how much?
    a. 1/2 inch
    b. 1/8 inch
    c. 1/4 inch
    d. 1 inch.
3. Which is the proper repair for a belt that is glazed?
    a. Wash with gas and dry off with air.
    b. Tighten the belt up more.
    c. Soap it down, it will take care of itself.
    d. None of the above, replace it.

PERFORMANCE OBJECTIVE V-TECS 100 (Continued)

Answers:
1. e
2. c
3. d

PERFORMANCE GUIDE:
1. Remove spark plug wire.
2. Remove belt guard.
3. Remove belt tension.
4. Remove old belt.
5. Install new belt.
6. Adjust the belt to manufacturer's specifications.
7. Replace spark plug wire.
8. Check for proper operation.

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 101

TASK: Replace throttle cable.

STANDARD OF PERFORMANCE OF TASK: The throttle cable should be replaced so that it opens the throttle fully and closes to idle speed without binding.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Throttle cable, bending pliers and manufacturer's specifications.

ENABLING OBJECTIVES:

1. Identify a throttle cable.
2. Describe a set of bending pliers.
3. Read and interpret the appropriate manufacturer's specifications.

RESOURCE:
Service and Repair Instructions, Briggs and Stratton, Vol. 4, Section 4.

TEACHING ACTIVITIES:

1. Read and discuss text **Briggs and Stratton Repair Instructions,** Vol. 4, Section 4.
2. Lecture to students on how the throttle response is directly related to the governor.
3. Demonstrate how the engine responds with the governor connected and disconnected.
4. Demonstrate the proper removal and replacement of a throttle cable.
5. In a guided learning activity, have the students remove and replace a throttle cable.

CRITERION REFERENCE MEASURE:
Questions:

1. The throttle cable is connected directly to the:
    a. Governor.
    b. Carburetor.
    c. Both carburetor and governor.
    d. It depends on the manufacturer and the use.
2. When connecting the throttle cable:
    a. You should make sure the throttle opens and closes all the way after replacement.
    b. Just replace it and put it in the same place it was in. They are all the same length.
    c. If it doesn't fit just bend the linkage to make it fit properly.
    d. Remove the carburetor first.

3. After replacing a throttle, you try to start the engine and cannot. The mower had been running. What is the probable cause?
   - a. Out of gas
   - b. Spark plug dead
   - c. Engine frozen up
   - d. Grounding switch grounded.

Answers:

1. d
2. a
3. d

PRACTICAL EVALUATION:
Replace a throttle cable so that it opens the throttle fully and closes to idle speed without binding.

METHOD OF EVALUATION:
Use Checklist Performance Objective 101 to determine if the assignment was completed with at least 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 101 EVALUATION

PERFORMANCE TEST FOR REPLACING A THROTTLE CABLE

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace a throttle cable so that the carburetor opens fully and closes to an idle without binding.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student follows safety standards. Work should be completed in a reasonable time limit with at least 90 percent accuracy.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed retaining screws.	__________	__________
2. Removed cable clamp on engine.	__________	__________
3. Removed handle cable clips.	__________	__________
4. Installed new cable.	__________	__________
5. Adjusted cable for proper travel.	__________	__________
6. Checked for proper operation.	__________	__________
7. Observed all safety rules.	__________	__________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING LAWN MOWER ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 102

TASK: Replace clutch.

STANDARD OF PERFORMANCE OF TASK: The clutch should operate so that it engages and disengages the engine from the drive train smoothly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and materials.

ENABLING OBJECTIVES:

1. Identify and use a standard set of small engine tools.
2. Describe a clutch.

RESOURCE:
Billet. **Small Gas Engines and Power Transmission Systems,** pp. 171-185.

TEACHING ACTIVITIES:

1. Read and discuss text **Small Gas Engines and Power Transmission Systems,** pp. 171-185.
2. Exhibit for the students the different types of clutches used on small engines.
3. Lecture to students on the importance of proper maintenance of clutches.
4. Demonstrate the proper removal and replacement of a clutch assembly.
5. In a guided learning activity, have the students remove and replace a clutch assembly on a given engine.

CRITERION REFERENCED MEASURE:
Questions:

1. What type of clutch is used on a small engine?
   a. Electric
   b. Hydraulic
   c. Friction
   d. Gas.
2. A centrifugal clutch relies on what to cause the friction?
   a. Flyweights
   b. Roundweights
   c. Springs
   d. All of the above.
3. The purpose of the clutch is to:
   a. Grab the engine and carry it with it;
   b. Transmit power from the engine to the drive;
   c. Help the brakes in stopping the mower;
   d. To help the starter.

PERFORMANCE OBJECTIVE V-TECS 102 (Continued)

Answers:

1. c
2. a
3. b

PERFORMANCE GUIDE:

1. Remove spark plug wire.
2. Remove clutch guard.
3. Remove clutch retaining screws.
4. Remove clutch with puller.
5. Replace clutch.
6. Check for alignment and proper operation.
7. Replace spark plug wire.

SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 103

TASK: Replace and adjust chain.

STANDARD OF PERFORMANCE OF TASK: The new chain must be installed on the sprocket and bar with the depth gauge facing the direction the chain will travel. Chain tension must be adjusted such that one drag link can be pulled out of the bar using thumb and forefinger or to manufacturer's specifications.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A new chain, a chain saw in need of chain replacement, and the necessary tools.

ENABLING OBJECTIVES:

1. Identify different chain sizes and types.
2. Identify chain tension screw.
3. Identify chain bar attaching points and types of bars.

RESOURCE:
Chain Saw Service Manual, 6th edition, pp. 30-36.
McCulloch Chain Saw Owners Manual, Number 91015, pp. 7-8.

TEACHING ACTIVITIES:

1. Describe importance of correct chain tension.
2. Compare types of chains and bars.
3. Describe how to break in a new chain.
4. Demonstrate how to install chain on shop saw.
5. Review procedure for setting chain tension.

CRITERION REFERENCED MEASURE:
Questions:

1. Correct chain tension will increase the life of:
    a. Chain
    b. Engine
    c. Both a and b.
2. Chain tension can be set when chain and bar are:
    a. Hot
    b. Cold
    c. Warm.
3. What happens if chain is tight or over tensioned?
    a. Wear on guide bar
    b. Wear on side links
    c. Both.

PERFORMANCE OBJECTIVE V-TECS 103 (Continued)

Answers:

1. c
2. b
3. c

PERFORMANCE GUIDE:

1. Wear gloves when handling chain. Cutter links are very sharp.
2. Remove old chain from bar and sprocket.
3. Clean bar groove and oil hole in the bar.
4. Determine pitch and gauge of old chain.
5. Select a new chain.
6. Turn chain tension screw to tighten chain.
7. Hold bar nose up and tighten bar mounting nut.
8. Chain should easily slide around bar.

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 104

TASK: Set cutting depth.

STANDARD OF PERFORMANCE OF TASK: The depth of cut should be set within ± 0.005" of that recommended by the manufacturer for the type of wood to be cut.

SOURCE OF STANDARD:
Chain Saw Service Manual. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A chain saw and a depth gauge.

ENABLING OBJECTIVES:

1. Identify the parts of a chain.
2. Read and follow technical instructions.
3. Read chain charts.

RESOURCE:
Chain Saw Service Manual, 6th edition, pp. 30-36.

TEACHING ACTIVITIES:

1. Define the term "cutting depth."
2. Demonstrate the use of a depth gauge tool.
3. Discuss problems of too little cutting depth and too much cutting depth.
4. Discuss manufacturer's recommended depth gauges for various cutters.
5. Explain and demonstrate the tools used to set cutting depth.
6. Demonstrate the correct procedure for sharpening with a machine grinder.

CRITERION REFERENCED MEASURE:

Questions:

1. Special tool used for holding chain so it can be filed and checked for depth:
   a. File vise
   b. File holder
   c. File guide.
2. Special tool used for checking and filing the depth gauge:
   a. File gauge
   b. File guide
   c. Depth gauge.
3. Portion of the left and right hand cutter which allows the cutting edge to protrude a certain distance into the surface being cut:
   a. Stroke
   b. Depth gauge
   c. Cutter angle.

Answers:

1. a
2. b
3. b

PRACTICAL APPLICATION:

The student will set the depth of cut on chain saw to factory specifications and increase the depth of cut by .010 of an inch for cutting softwood.

METHOD OF EVALUATION:

Use checklist Performance Objective 104 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 104 EVALUATION

PERFORMANCE TEST FOR SETTING CUTTING DEPTH

Student's Name **Date**

DIRECTIONS TO STUDENT: Set two depth gauges to cutting depth on chain to factory specifications. Have instructor check, then set cutting depth .010 of inch deeper for soft wood and have instructor check.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper tools.		
2. Student used correct file.		
3. Student looked up depth setting in shop manual.		
4. Student used all safety equipment needed for the job.		
5. Student used depth gauge properly.		
6. Student increased cutting depth by .010 of an inch for cutting softwood.		
7. The student followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 105

TASK: Check and adjust oiler.

STANDARD OF PERFORMANCE OF TASK: The oiler must be adjusted so that the chain links are coated with a light film of oil at all times.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A chain saw with an automatic oiler.

ENABLING OBJECTIVES:

1. Define terms and definitions having to do with oilers.
2. Describe categories of oilers.
3. Describe types of automatic oilers.
4. Explain operation of automatic oilers.

RESOURCE:
Chain Saw Service Manual, 6th Edition, pp. 50-52, 62-73, 83-109.

TEACHING ACTIVITIES:

1. Provide examples of chain saws with different types of chain oilers.
2. Discuss the different components of oil pumps.
3. Discuss the advantages and disadvantages of the various types of chain oilers.
4. Discuss troubleshooting procedures for each type of chain oiler.
5. Demonstrate and explain oil pump repair of each type of pump.

CRITERION REFERENCED MEASURE:
Questions:

1. Non-automatic oiler pump which is activated by the machine operator:
    a. Gear pump
    b. Automatic oiler pump
    c. Manual oiler pump.
2. Tank which stores oil to be transferred to the bar for lubrication during sawing operation:
    a. Oil reservoir
    b. Regulator valve
    c. Automatic oiler pump.
3. Device which allows pressurized fluid to pass in only one direction:
    a. Oil reservoir
    b. Check valve
    c. Regulator valve.

PERFORMANCE OBJECTIVE V-TECS 105 (Continued)

Answers:

1. c
2. a
3. b

PRACTICAL APPLICATION:
The student will check and adjust the oiler on cam operated oil pump and the pulsation pump. The student will assemble and prime manual pump. All pumps must be set as to coat chain at all times.

METHOD OF EVALUATION:
Use checklist Performance Objective 105 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 105 EVALUATION

PERFORMANCE TEST FOR CHECKING AND ADJUSTING OILERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Check and adjust oilers on three types of chain saws given to you by instructor. Each saw has a different kind of oiler. Each oiler is to be set to factory specifications.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent accuracy.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used the proper manual.		
2. Student used proper tools.		
3. Student used safety equipment needed for the job.		
4. Student cleaned oil ports.		
5. Student checked and adjusted oiler to see that it was putting out proper amount of oil.		
6. The student followed all safety procedures.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 106

TASK: Lubricate roller nose bar.

STANDARD OF PERFORMANCE OF TASK: The bar should be lubricated so that the grease completely fills the nose openings.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A hand grease gun.

ENABLING OBJECTIVES:
1. Identify types of bars.
2. Identify parts of bar assembly.

RESOURCE:
Chain Saw Service Manual, 6th Edition, pp. 33-35.

TEACHING ACTIVITIES:
1. Show examples of different types of bars.
2. Show examples of damaged bars and discuss possible causes of damage.
3. Discuss the advantages and disadvantages of the various types of bars.
4. Disassemble a bar so that students can identify various parts.
5. Demonstrate and explain how to lubricate a roller nose bar.

CRITERION REFERENCED MEASURE:

Questions:
1. When lubricating a roller nose bar how much lubrication should be used?
    a. One squirt of oil
    b. Fill cavity with oil
    c. Fill cavity with grease.
2. The roller nose bar should be greased:
    a. Every hour
    b. Every day
    c. Once a month.
3. What type of grease gun is used to lubricate nose roller bar?
    a. Chasis gun
    b. Needle nose gun
    c. Either gun.

Answers:
1. c
2. a
3. b

PRACTICAL APPLICATION:
The student will lubricate the nose roller bar as described in manual.

METHOD OF EVALUATION:
Use checklist Performance Objective 106 to determine if the assignment was completed with at least 100 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 106 EVALUATION

PERFORMANCE TEST FOR LUBRICATING NOSE ROLLER BAR

Student's Name **Date**

DIRECTIONS TO STUDENT: Using shop chainsaw, lubricate roller nose bar as per factory specifications.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure student follows all safety standards. Work should be completed in a reasonable time at 100 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper tools.	___	___
2. Student cleaned lubrication opening.	___	___
3. Student used proper grease.	___	___
4. Student followed all safety standards.	___	___

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 108

TASK: Replace worn sprockets.

STANDARD OF PERFORMANCE OF TASK: The sprocket must be replace and the bar adjusted so that the sprocket engages the chain without slippage.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A set of sprocket wrenches and a chain saw.

ENABLING OBJECTIVES:

1. Describe the operation of the automatic clutch.
2. Name the parts of the clutches and sprocket systems.

RESOURCES:

Chain Saw Service Manual, p. 36.
Mini-Mac Series Chain Saw Supplement To Owner Manual, p. 8.

TEACHING ACTIVITIES:

1. Describe the differences between direct drive and gear drive assemblies on actual saws available in the classroom.
2. Describe and show two types of drive sprockets.
3. Provide examples of bearings used in chain saw drive units.
4. Demonstrate how to remove sprockets and clutches on shop saws.
5. Discuss what problems worn sprockets can cause.
6. Demonstrate how sprockets are replaced.
7. Caution students not to try and crank engine until clutch is completely assembled.

CRITERION REFERENCED MEASURE:

Questions:

1. The device that transfers power of engine to chain is called:
   a. Sprocket.
   b. Idler gear.
   c. Centrifugal clutch.
2. Self aligning sprockets have a:
   a. Fixed sprocket
   b. Floating sprocket
   c. Idle sprocket.
3. The sprocket is attached to:
   a. Drum
   b. Cup
   c. Either.

Answers:

1. c
2. b
3. c

PRACTICAL APPLICATION:

The student will replace worn sprockets on shop chain saws. All clutches and drums will be checked. Also grease and check bearing in drum or cup.

METHOD OF EVALUATION:

Use checklist Performance Objective 108 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 108 EVALUATION

PERFORMANCE TEST FOR REPLACING WORN SPROCKET

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace sprocket on two types of clutches, integral star and self-aligning. Check and grease bearing.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper safety equipment and procedures.	________	________
2. Student cleaned sprocket and clutch.	________	________
3. Student greased bearing in drum.	________	________
4. Remove cover and bar to replace sprocket.	________	________
5. Removed sprocket retainer.	________	________
6. Installed new sprocket.	________	________
7. Tightened sprocket retainer.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 109

TASK: Replace broken drive link.

STANDARD OF PERFORMANCE OF TASK: The link must be replaced so that it engages the sprocket and the chain is flexible.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A chain breaker, a hammer, a punch and rivets.

ENABLING OBJECTIVES:

1. Identify the parts of chain.
2. Match chain sizes.

RESOURCE:
Chain Saw Service Manual, pp. 30-34.

TEACHING ACTIVITIES:

1. Describe tools used to repair chain.
2. Demonstrate how each tool is used.
3. Review parts of chain with students.
4. Explain problems that will occur if repaired link is too tight.
5. Explain repair procedure in completion.
6. Demonstrate repair procedure completely.

CRITERION REFERENCED MEASURE:

Questions:

1. Tool used to finish rivet head:
   a. Chain breaker
   b. Rivet spinner
   c. Pliers.
2. Tool used to separate chain:
   a. Chain breaker
   b. Multipurpose tool
   c. Both.
3. The chain breakers that are not bench mounted:
   a. Pocket chain breaker and bench breaker
   b. Bench breaker and multi-purpose tool
   c. Pocket breaker and multi-purpose tool

Answers:

1. b
2. c
3. c

PRACTICAL APPLICATION:
The student will replace broken drive link in shop chain saw chain, using shop chain breaker and rivet spinner.

METHOD OF EVALUATION:
Use Checklist Performance Objective 109 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 109 EVALUATION

PERFORMANCE TEST FOR REPLACING DRIVE LINK

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace broken drive link in chain saw chain, using shop chain breaker and rivet spinner.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable amount of time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper safety equipment and procedures.	____	____
2. Student broke chain with shop chain breaker using right mandrel.	____	____
3. Student checked to see that new parts lined up directionally with the remainder of the chain.	____	____
4. Student formed rivet heads on rivet spinner.	____	____
5. Student checked chain for tightness of rivet fit in the repair job.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 110

TASK: Replace a roller on a cutter bar.

STANDARD OF PERFORMANCE OF TASK: The replaced roller must allow the chain to travel freely within its track. The roller must rotate without binding.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Needed tools and materials.

ENABLING OBJECTIVES:

1. Identify chain size.
2. Describe construction of bars.
3. Name types of bars.

RESOURCE:
Chain Saw Service Manual, 6th edition, pp. 30-36.

TEACHING ACTIVITIES:

1. Discuss chain and sprocket sizes.
2. Explain nose roller bar construction.
3. Demonstrate how rivets are removed.
4. Explain and demonstrate how to open rivets.
5. Demonstrate completed repair job and review process.
6. Explain and discuss problems of unmatched chain and sprockets.

CRITERION REFERENCED MEASURE:

Questions:

1. What holds nose bar roller to bar?
    a. Screws
    b. Rivets
    c. Bolts.
2. How are rivets removed from bar?
    a. Punch
    b. File
    c. Both.
3. Nose roller should be replaced with:
    a. Small screws
    b. Bolts and nuts
    c. New rivets.

Answers:

1. b
2. c
3. c

PERFORMANCE OBJECTIVE V-TECS 110 (Continued)

PRACTICAL APPLICATION:
Student will replace a nose roller on a cutterbar on shop chain saw.

METHOD OF EVALUATION:
Use Checklist Performance Objective 110 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 110 EVALUATION

PERFORMANCE TEST FOR REPLACING NOSE ROLLER BAR

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace nose roller on cutter bar.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable amount of time at 80 percent accuracy.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper safety equipment and procedures.		
2. Student removed cutter bar.		
3. Student ground off rivet heads on one side of the bar.		
4. Student punched out rivets and removed roller.		
5. Student greased bearing with chassis grease.		
6. Student inserted new roller into bar.		
7. Student inserted new rivets and peened the heads.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS SCO4

TASK: Service chain saw.

STANDARD OF PERFORMANCE OF TASK: Chain saw must operate to meet manufacturer's specifications.

SOURCE OF STANDARD:
Writing Team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Handtool assortment, air filter, spark plug, air hose, oil and gasoline mixed to manufacturer's specifications, service manual, and clean workbench and clean rags.

ENABLING OBJECTIVES:

1. Identify necessary tools.
2. Identify parts of a chain saw.
3. Read and interpret a manufacturer's specification chart.
4. Read a feeler gauge.
5. Identify correct replacement of parts.

RESOURCE:
Stephenson, **Small Gasoline Engines,** pp. 110-117.

TEACHING ACTIVITIES:

1. Discuss different types of chain saws.
2. Discuss parts of chain saws.
3. Explain the difference in service manuals.
4. Take a field trip to a local small engine shop.
5. Demonstrate disassembly of parts.
6. Show how to clean parts.
7. Explain importance of placing parts back in correct place.
8. Place parts back on chain saw.
9. Have student demonstrate removal of parts.
10. Have student demonstrate cleaning of parts.
11. Have student demonstrate reassembly of parts.

CRITERION REFERENCED MEASURE:

Questions:

1. An ___________ ___________ helps keep dust and dirt from entering an engine.
2. Use a ___________ ___________ to set the spark plug.
3. ___________ ___________ and spark are necessary in order for a chain saw to operate correctly.

Answers:

1. Air filter
2. Feeler gauge
3. Fuel, compression

PRACTICAL APPLICATION:
Service chain saw to meet manufacturer's specifications.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SCO4 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS SCO4 EVALUATION

PERFORMANCE TEST FOR SERVICING A CHAIN SAW

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. The student followed all safety precautions.	______	______
2. The proper tools were used.	______	______
3. A manufacturer's specification chart was used.	______	______
4. The work area was clean.	______	______
5. The student followed instructions in the service manual.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND MAINTAINING CHAIN SAW ASSEMBLIES

PERFORMANCE OBJECTIVE V-TECS 112

TASK: Trouble-shoot cutter problems.

STANDARD OF PERFORMANCE OF TASK: The conclusion reached must be the same as that of the instructor or an experienced mechanic.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A malfunctioning cutter.

ENABLING OBJECTIVES:

1. Explain the function of chain and bar on plain cutter bar.
2. Explain the function of chain and bar with nose roller.
3. Explain differences in cutters on chain.

RESOURCE:
Chain Saw Service Manual, pp. 34.

TEACHING ACTIVITIES:

1. Compare an old chain with a new chain.
2. Discuss problems that would occur if old worn chain was used.
3. Demonstrate what happens if a link is stiff.
4. Compare old chains with chart for trouble shooting common problems which is on page 34 in **Chain Saw Service Manual.**
5. Discuss each item on the troubleshooting chart with reference to old or worn chains supplied by instructor.

CRITERION REFERENCED MEASURE:
Questions:

1. A sharp chain requires:
   a. Less fuel
   b. Cuts smoother
   c. Both.
2. Fine sawdust is a product of:
   a. Sharp chain
   b. Dull chain
   c. Wrong chain.
3. The back and front of drive link peened:
   a. Worn sprocket
   b. Wrong pitch sprocket
   c. Dull chain
   d. a and b.

Answers:
1. c
2. b
3. d

PRACTICAL APPLICATION:
The student will trouble shoot old shop chains and tell instructor what problems chains would cause.

METHOD OF EVALUATION:
Use Checklist Performance objective 112 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 112 EVALUATION

PERFORMANCE TEST FOR TROUBLE-SHOOTING CUTTER PROBLEMS

Student's Name **Date**

DIRECTIONS TO STUDENT: Student will troubleshoot problems using old shop chains. Each chain will be checked by student and student will tell instructor what problem could have happened with the use of that chain.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student checked chains given to him and discussed with instructor what he found wrong and what problems they would cause.	____	____
2. Student followed all safety procedures.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 113

TASK: Clean outboard motors.

STANDARD OF PERFORMANCE OF TASK: The motor will be cleaned so that it is free of grease and dirt accumulations and parts are not damaged in the cleaning process.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Degreaser and a supply of clean water.

ENABLING OBJECTIVES:

1. Identify parts of power head.
2. Identify lubrication points for controls.

RESOURCE:
Directions on cleaner.

TEACHING ACTIVITIES:

1. Discuss types of degreasers and how to use them.
2. identify parts of powerhead that degreaser can harm.
3. Identify and explain why degreaser should not be applied to ignition parts.
4. Demonstrate how engine is to be cleaned and dried.
5. Review safety procedures in handling degreaser.

CRITERION REFERENCED MEASURE:

Questions:

1. Some degreasers can:
   a. Harm ignition systems
   b. Cause corrosion
   c. Both.
2. Engines are to be:
   a. Dried by outside air
   b. Dried by compressed air
   c. Dried by cranking engine and letting it run.
3. After engine has been cleaned:
   a. Put on cowl
   b. Lube control joints
   c. Wipe off plug wires.

Answers:

1. c
2. b
3. b

PERFORMANCE OBJECTIVE V-TECS 113 (Continued)

PRACTICAL APPLICATION:

The student will clean outboard power head removing oil and grease making sure not to damage any parts.

METHOD OF EVALUATION:

Use Checklist Performance Objective 113 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 113 EVALUATION

PERFORMANCE TEST FOR CLEANING POWER HEAD

Student's Name **Date**

DIRECTIONS TO STUDENT: Clean power head using correct degreaser removing dirt, oil and grease making sure not to damage any other parts.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student used proper degreaser.	____	____
2. Student covered parts that degreaser could harm.	____	____
3. Student used safety precautions.	____	____
4. Student blew parts dry with air gun.	____	____
5. Student oiled or greased parts that could oxidize.	____	____
6. Student followed all safety procedures.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 114

TASK: Replace worn or defective gear drive components on outboard engines.

STANDARD OF PERFORMANCE OF TASK: The replaced drive gears must function without slippage or vibration.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and repair manual.

ENABLING OBJECTIVES:

1. Identify type of engine and lower unit to be worked on.
2. Read and interpret engine service manual, specifically lower unit instructions.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-3 -- 6-6.

TEACHING ACTIVITIES:

1. Describe how different lower units work.
2. Explain and demonstrate how to use special tools needed to work on different units.
3. Explain the different parts and their function in the lower unit.
4. Explain how water pump works off of drive shaft and how water gets to power head.
5. Demonstrate the complete job of replacing gears, bearings and seals using the Service Manual.

CRITERION REFERENCED MEASURE:
Questions:

1. The gear on the lower end of the drive shaft is:
   a. Clutch dog
   b. Pinion
   c. Thrust washer.
2. The purpose of the seals in the foot of engines is to:
   a. Keep oil in
   b. Keep water out
   c. Both.
3. To fill lower unit with oil:
   a. Remove vent screw and fill plug.
   b. Put oil in from bottom until it comes out the vent.
   c. Pack unit before assembly.
   d. Put oil in top until it comes out the bottom.

PERFORMANCE OBJECTIVE V-TECS 114 (Continued)

Answers:
1. b
2. c
3. b

PRACTICAL APPLICATION:
The student will replace clutchdog and forward gear in lower unit of shop engine.

METHOD OF EVALUATION:
Use Checklist Performance Objective 114 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 114 EVALUATION

PERFORMANCE TEST FOR REPLACING DEFECTIVE GEAR DRIVE COMPONENT

Student's Name **Date**

DIRECTIONS TO STUDENT: Student will replace clutch and forward gear in lower unit of shop engine.

DIRECTIONS TO EVALUATOR: Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Student used proper tools.	______	______
2.	Student removed parts blocking access to drive mechanism.	______	______
3.	Student removed worn parts.	______	______
4.	Student reassembled and checked to see that clutch and forward gear worked as it should.	______	______
5.	Student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 115

TASK: Lubricate lower unit.

STANDARD OF PERFORMANCE OF TASK: The lower unit should be lubricated so that the gears do not slip, overheat or wear excessively.

SOURCE OF STANDARD:
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
Manufacturer's specifications, grease and oil.

ENABLING OBJECTIVES:

1. Describe power head, exhaust housing and lower unit.
2. Identify lower unit.

RESOURCE:

Johnson Service Repair Handbook 40 to 140 HP 1965-1977, Section 2, pp. 45.

TEACHING ACTIVITIES:

1. Explain types of oils or grease used in lower unit.
2. Describe the interval of service for lower unit.
3. Identify vent hole and drain fill hole and explain their function.
4. Demonstrate how to check and fill lower unit with oil.
5. Discuss problems that will occur without proper level of oil in lower unit.

CRITERION REFERENCED MEASURE:

Questions:

1. To fill lower unit with oil the:
   a. Oil drain plug is removed;
   b. Vent plug is removed;
   c. Both are removed.
2. To fill lower unit oil is put in:
   a. Drain hole
   b. Fill hole
   c. Either.
3. To drain lower unit engine should be:
   a. Laying down
   b. Standing upright
   c. Tilted.

Answers:

1. c
2. a
3. b

PERFORMANCE OBJECTIVE V-TECS 115 (Continued)

PRACTICAL APPLICATION:
The student will lubricate lower units in two types of outboard engines, checking to see that there is no seal leak around prop shaft.

METHOD OF EVALUATION:
Use Checklist Performance Objective 115 to determine if the assignment was completed with at least 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 115 EVALUATION

PERFORMANCE TEST FOR LUBRICATING LOWER UNITS

Student's Name **Date**

DIRECTIONS TO STUDENT:	Lubricate the lower units of two shop engines checking for leaks at propshaft.
DIRECTIONS TO EVALUATOR:	Observe student. Pay close attention to items to be evaluated. Be sure the student follows all safety standards. Work should be completed in a reasonable time at 80 percent proficiency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Student selected proper gear oil.	______	______
2. Student removed top plug from lower unit.	______	______
3. Student removed lower plug.	______	______
4. Student checked for water in oil.	______	______
5. Student inserted in bottom hole and filled lower unit until oil came out top hole.	______	______
6. Student replaced bottom plug then top plug.	______	______
7. Student checked around prop shaft for leak in seal.	______	______
8. Student followed all safety procedures.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 116

TASK: Inspect and install propellers and shear pins.

STANDARD OF PERFORMANCE OF TASK: The propeller and shear pin must be installed such that the pin is fully inserted and locks the propeller to the drive shaft.

SOURCE OF STANDARD:
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A new propeller, shear pen, and necessary hand tools.

ENABLING OBJECTIVES:

1. Identify clutch type propeller and shear pin propeller.
2. Identify lower unit.

RESOURCES:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-2 -- 6-10.

TEACHING ACTIVITIES:

1. Explain the theory of how a propeller works.
2. Describe what effect nicks and cracks might cause.
3. Demonstrate how to remove small nicks with a file and how to straighten a propeller blade.
4. Explain purpose of shear pin.
5. Identify the need to use shear pin that will break easily.
6. Demonstrate how to remove propeller and replace shear pin.

CRITERION REFERENCED MEASURE:
Questions:

1. Shear pins are made of:
    a. Iron
    b. Steel
    c. Brass.
2. The purpose of the shear pin is to:
    a. Keep propeller on shaft.
    b. Keep propeller from breaking propeller shaft.
    c. Both.
3. If shear pin is too small for engine it could:
    a. Break under load
    b. Break if engine cavitated
    c. Both.

PERFORMANCE OBJECTIVE V-TECS 116 (Continued)

Answers:

1. c
2. b
3. c

PERFORMANCE GUIDE:

1. Pull cotter pin from propeller shaft.
2. Remove propeller nut.
3. Remove propeller and shear pin.
4. Replace propeller and shear pin.
5. Replace nut and cotter pin.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 117

TASK: Inspect and replace the bearing and drive shaft.

STANDARD OF PERFORMANCE OF TASK: The decision made to replace must agree with that of the instructor. The bearing and driveshaft must be replaced in such a manner that the clearances are as specified by the manufacturer and all bolts are torqued to standard.

SOURCE OF STANDARD:
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Manufacturer's specifications and tools.

ENABLING OBJECTIVES:

1. Identify engine and foot type.
2. Read and interpret engine repair manual, specifically the section on shaft repair.

RESOURCES:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-2 -- 6-10.

TEACHING ACTIVITIES:

1. Explain location of drive shaft and its function.
2. Describe location of water pump and how it works.
3. Identify all parts that will be removed.
4. Discuss parts that will be removed from engine to get foot off of powerhead.
5. Demonstrate drive shaft replacement on shop engine installing new bearings.
6. Discuss problems of bad bearings.

CRITERION REFERENCED MEASURE:
Questions:

1. Bad bearings can cause:
   a. Oil to leak from lower unit;
   b. Water pump not to work;
   c. Both.
2. What gear is on the lower end of the drive shaft?
   a. Pinion gear
   b. Reverse gear
   c. Forward gear.
3. Drive shaft bearing is located on the:
   a. Lower gear case
   b. Upper gear case
   c. In both cases.

PERFORMANCE OBJECTIVE V-TECS 117 (Continued)

Answers:

1. c
2. a
3. b

PERFORMANCE GUIDE:

1. Remove parts blocking access to bearings and drive shaft.
2. Remove worn parts.
3. Replace worn parts.
4. Reassemble lower unit.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 118

TASK: Remove and reinstall the drive shaft pinion on an outboard motor.

STANDARD OF PERFORMANCE OF TASK: The pinion must be removed in such a manner that no parts are damaged and installed to that clearances are as specified by the manufacturer.

SOURCE OF STANDARD:
Outboard Service Manual, Vol. I. Intertec Publishing Corporation.

CONDITIONS FOR PERFORMANCE OF TASK:
The necessary tools.

ENABLING OBJECTIVES:

1. Identify engine and foot type.
2. Read and interpret engine repair manual specifically on the section on drive shaft pinion.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-2 -- 6-10.

TEACHING ACTIVITIES:

1. Explain location of drive shaft pinion and its function.
2. Describe location of parts to be removed.
3. Identify all parts to be removed.
4. Demonstrate drive shaft pinion replacement on shop engine installing new pinion.
5. Discuss problems of a bad pinion gear.

CRITERION REFERENCED MEASURE:

Questions:

1. Bad pinion can cause:
   a. Noise
   b. Propeller not to turn
   c. Both.
2. What gear is on the lower end of the drive shaft?
   a. Pinion gear
   b. Reverse gear
   c. Forward gear.
3. To remove pinion gear the:
   a. Foot has to be removed;
   b. The water pump has to be removed;
   c. Both.

Answers:

1. c
2. a
3. c

PERFORMANCE OBJECTIVE V-TECS 118 (Continued)

PERFORMANCE GUIDE:

1. Remove oil in lower unit.
2. Remove parts blocking access to pinion.
3. If the pinion is worn beyond manufacturer's specifications, replace it.
4. Reassemble it. Refill oil in foot.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 119

TASK: Remove and replace powerhead from lower unit.

STANDARD OF PERFORMANCE OF TASK: All lever controls and connections must work freely and engine must operate as original equipment.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Manufacturer's manual and hand tools.

ENABLING OBJECTIVES:

1. Identify engine make and type.
2. Read and interpret Service Shop Manual specifically the section on head removal.

RESOURCE:

Evinrude Service Manual, 1972, Item 4813, Section 5, pp. 5-4.

TEACHING ACTIVITIES:

1. Explain what the power head consist of.
2. Describe location of bolts holding power head.
3. Identify all parts that will be removed.
4. Discuss the replacement of gaskets.
5. Demonstrate power head removal on shop engine.
6. Discuss problems of a gear adjustment after powerhead has been replaced.

CRITERION REFERENCED MEASURE:

Questions:

1. The power head sits on:
   a. Exhaust housing assembly
   b. Lower unit
   c. Leaf valve assembly.
2. When power head is installed:
   a. Check to see if housing is clean;
   b. Use new gasket of exhaust housing;
   c. Both.
3. When power head has been replaced:
   a. Check leakage to throttle;
   b. Check shift lever;
   c. Both.

Answers:

1. a
2. c
3. c

PERFORMANCE OBJECTIVE V-TECS 119 (Continued)

PERFORMANCE GUIDE:

1. Remove parts blocking access to powerhead.
2. Remove bolts holding head to lower unit.
3. Remove powerhead.
4. Replace powerhead base gasket.
5. Replace powerhead.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 120

TASK: Remove and replace swivel bracket.

STANDARD OF PERFORMANCE OF TASK: The replaced bracket must work smoothly without binding.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and manufacturer's manual.

ENABLING OBJECTIVES:

1. Identify engine.
2. Read and interpret Repair Service Manual specifically the section on swivel bracket.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 6-6, pp. 6-6 -- 6-7.

TEACHING ACTIVITIES:

1. Discuss the function of swivel bracket.
2. Describe location of swivel bracket.
3. Identify all parts to be removed.
4. Demonstrate on shop engine how swivel brackets are removed and installed.
5. Discuss problems in removing swivel brackets.

CRITERION REFERENCED MEASURE:

Questions:

1. The swivel bracket is:
   a. Attached to exhaust housing
   b. Powerhead
   c. Stern bracket
2. The swivel bracket allows the engine to:
   a. Turn right or left
   b. Tilt
   c. Both.
3. The steering tension plate is located:
   a, On top of swivel bracket
   b. On bottom of swivel bracket
   c. Both.

Answers:

1. c
2. c
3. a

PERFORMANCE OBJECTIVE V-TECS 120 (Continued)

PERFORMANCE GUIDE:

1. Remove parts blocking access to swivel bracket.
2. Remove swivel bracket.
3. Replace swivel bracket if damaged.
4. Replace parts blocking access to swivel bracket.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 122

TASK: Lubricate transom steering bushing.

STANDARD OF PERFORMANCE OF TASK: There will be no binding in the transom steering bushing. The lubricants used will be those recommended by the manufacturer.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Tools and equipment and manufacturer's manual.

ENABLING OBJECTIVES:

1. Identify transom bracket.
2. Read and interpret service manual.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 2, pp. 2-5.

TEACHING ACTIVITIES:

1. Explain the reasons for lubricating engine at this point.
2. Describe location of steering bushing.
3. Identify lubrication point (grease fitting).
4. Demonstrate on shop engine how steering bushings are lubricated.
5. Discuss problems of not keeping this point well greased.

CRITERION REFERENCED MEASURE:
Questions:

1. If steering bushing is not greased:
    a. Steering could lock;
    b. Steering bushing would get water in it;
    c. Steering bushing could corrode;
    d. All of the above.
2. The steering bushing is located:
    a. Under lower unit
    b. In the stern bracket assembly
    c. Inside swivel bracket.
3. Steering bracket should be lubricated with:
    a. Oil
    b. Grease
    c. Both.

PERFORMANCE OBJECTIVE V-TECS 122 (Continued)

Answers:
1. d
2. c
3. b

PERFORMANCE GUIDE:
1. Select a steering lubricant according to manufacturer's specifications.
2. Obtain a grease gun.
3. Clean grease fitting.
4. Attach gun nozzle. Apply grease. Stop application when grease protrudes from bushings.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 123

TASK: Remove, clean and replace gas tank pickup tube.

STANDARD OF PERFORMANCE OF TASK: The pick-up tube must be cleaned and replaced so that gas glows freely from the tank to the carburetor without leaking.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A gas tank and hand tools.

ENABLING OBJECTIVES:

1. Identify types of fuel tanks.
2. Explain how fuel is picked up in tanks.

RESOURCE:
Evinrude Service Manual, 1972, Items 4813, Section 3, pp. 3-10 -- 3-12.

TEACHING ACTIVITIES:

1. Explain how fuel pick up works.
2. Describe location of fuel pick-up.
3. Identify all parts to be checked and cleaned.
4. Demonstrate how to clean and replace gas tank pick-up tube on shop engine tank.
5. Discuss the problems of not having a clean fuel system.

CRITERION REFERENCED MEASURE:

Questions:

1. The fuel filter screen is located:
    a. End of pickup tube
    b. Between gas line and bulb
    c. Fuel line connector.
2. To clean fuel tank it should be:
    a. Flushed with clean gas
    b. Flushed with solvent
    c. Neither.
3. Fuel pickup tube is located under:
    a. Upper housing and fuel line assembly
    b. Gas cap
    c. Fuel bulb.

PERFORMANCE OBJECTIVE V-TECS 123 (Continued)

Answers:

1. a
2. c
3. a

PERFORMANCE GUIDE:

1. Remove pick-up tube from tank.
2. Examine for blockage and check ball movement.
3. Clean tank and examine for rust.
4. Replace gasket and pick-up tube if needed.
5. Check for leaks.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 124

TASK: Inspect or replace vertical drive gear on an outboard engine.

STANDARD OF PERFORMANCE OF TASK: The drive gear should be replaced such that it operates smoothly and without binding as it transfers power from the engine to the pinion.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
An outboard engine.

ENABLING OBJECTIVES:

1. Identify type foot or lower unit to be worked on.
2. Explain how lower unit drive gears work.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-3 -- 6-5.

TEACHING ACTIVITIES:

1. Explain what drives the drive gear.
2. Describe the location of the vertical drive gear.
3. Identify all of the main parts of the drive system.
4. Demonstrate on shop engine how vertical drive gear is removed and assembled.
5. Discuss problems that bad drive bearings cause and what happens if the clearance is wrong.

CRITERION REFERENCED MEASURE:
Questions:

1. The vertical drive gear is located in the:
    a. Upper gearcase
    b. Lower gearcase
    c. On the drive shaft.
2. To remove drive gear the:
    a. Drive shaft must be removed;
    b. Lower gearcase must be removed;
    c, Propeller shaft removed;
    d. B and c must be removed.
3. Vertical gear should be checked for:
    a. Clearance
    b. Wear
    c. Both.

PERFORMANCE OBJECTIVE V-TECS 124 (Continued)

Answers:

1. b
2. d
3. c

PERFORMANCE GUIDE:

1. Remove the lower unit.
2. Remove the lower gear case from lower unit.
3. Remove the drive shaft from the drive shaft housing and water pump.
4. Replace the vertical drive gear.
5. Reassemble,

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 125

TASK: Remove and replace clutch dog.

STANDARD OF PERFORMANCE OF TASK: The clutch dog must be replaced so that it engages both forward and reverse gears without binding or disengaging while in operation.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Hand tools and manufacturer's guide.

ENABLING OBJECTIVES:

1. Identify engine and foot type.
2. Read and interpret repair manual, specifically the section on clutch repair.
3. Explain how clutch works.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section 6, pp. 6-5 -- 6-6.

TEACHING ACTIVITIES:

1. Explain how clutches work.
2. Explain location of clutch.
3. Identify parts of clutch.
4. Discuss parts to be removed to install new clutch.
5. Demonstrate how clutch is replaced on shop engine.
6. Discuss problems that a bad clutch can cause.

CRITERION REFERENCED MEASURE:
Questions:

1. Where is clutch located?
    a. Upper gear housing
    b. Lower gear housing
    c. On propeller shaft
    d. c and d.
2. What moves the clutch dog?
    a. Shift lever and cradle
    b. Trust washer
    c. Pivot pin.
3. The clutch dog is moved:
    a. Forward for forward motion
    b. Backward for forward motion
    c. Remains in center.

Answers:

1. d
2. a
3. a

PERFORMANCE GUIDE:

1. Remove parts blocking access to clutch dog.
2. Remove clutch dog.
3. Replace clutch dog.
4. Reassemble.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 126

TASK: Remove and replace clutch coil.

STANDARD OF PERFORMANCE OF TASK: The clutch will engage or disengage provided all other components are functioning correctly.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
Hand tools and manufacturer's manual.

ENABLING OBJECTIVES:

1. Explain type of lower unit that uses clutch coil to change gears.
2. Locate electric shift in service manual.

RESOURCE:
Johnson Service Repair Handbook, HO to 140 H.P., 1965-1977, Section 7, pp. 182-194.

TEACHING ACTIVITIES:

1. Explain purpose of clutch coil.
2. Point out location of coil.
3. Identify parts to be removed to get to clutch coil.
4. Demonstrate on shop engine how clutch coil is replaced.
5. Discuss the effects of a short in clutch coil.

CRITERION REFERENCED MEASURE:

Questions:

1. The clutch coil is located in:
    a. Upper gearcase
    b. Lower gearcase
    c. Exhaust housing.
2. When clutch coil pulls shift lever up the propeller is in:
    a. Neutral
    b. Reverse
    c. Forward.
3. What effect does a short have on shift mechanism:
    a. Not shift at all
    b. Jump out of or into gear
    c. All of the above.

Answers:

1. a
2. b
3. c

PERFORMANCE OBJECTIVE V-TECS 126 (Continued)

PERFORMANCE GUIDE:

1. Remove parts blocking access to clutch coil.
2. Remove oil in foot.
3. Remove clutch coil and inspect.
4. Replace clutch coil.
5. Replace parts blocking access to clutch coil.
6. Refill foot with oil specified by manufacturer.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS 127

TASK: Replace seals in lower unit of an outboard engine.

STANDARD OF PERFORMANCE OF TASK: The seals must be replaced so that there are no oil or water leaks.

SOURCE OF STANDARD:
South Carolina Writing Team.

CONDITIONS FOR PERFORMANCE OF TASK:
A manufacturer's manual and hand tools.

ENABLING OBJECTIVES:

1. Explain the purpose of seals.
2. Explain how a seal works.

RESOURCE:
Evinrude Service Manual, 1972, Item 4813, Section C, pp. 6-1 -- 6-10.

TEACHING ACTIVITIES:

1. Explain location of seals in lower unit.
2. Identify parts to be removed to install seals.
3. Demonstrate how to install seals in the entire lower unit.
4. Explain how to check for leaks.
5. Discuss how seal leaks can be found and the problems leaks cause.

CRITERION REFERENCED MEASURE:

Questions:

1. All seals in lower unit can be changed without taking off lower unit.
   a. True
   b. False
2. Propeller shaft seal can be changed by:
   a. Removing propeller
   b. Removing lower unit
   c. Both.
3. The top seal in lower is under:
   a. Water pump
   b. Pinion gear
   c. Vertical drive gear.

Answers:

1. b
2. a
3. a

PERFORMANCE GUIDE:

1. Remove parts blocking access to seals.
2. Replace seals.
3. Replace parts removed.

DUTY: SERVICING, MAINTAINING AND REPAIRING OUTBOARD ENGINES, DRIVES AND ACCESSORIES

PERFORMANCE OBJECTIVE V-TECS SC05

TASK: Troubleshoot lower unit.

STANDARD OF PERFORMANCE OF TASK: Engine must be serviced or repaired to meet the manufacturer's specifications.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Special tool assortment, service manual, manufacturer's specifications chart, clean work area, cleaning solvent tank and clean rags.

ENABLING OBJECTIVES:

1. Read and interpret a service manual.
2. Identify necessary tools.
3. Identify parts of an outboard engine.

RESOURCES:

Service Manual, Chrysler Outboard, Section 6.
Outboard Engines (Slide.)
Stephenson, **Small Gasoline Engines,** pp. 75-76.

TEACHING ACTIVITIES:

1. Show slide presentation (Outboard Engines).
2. Discuss parts of an outboard engine.
3. Show special tools that will be used.
4. Demonstrate how to disassemble engine to locate the lower unit.
5. Have a student identify the lower unit parts of the engine.
6. Demonstrate how to check for necessary repairing/servicing.
7. Demonstrate how to reassemble the lower unit parts.
8. Have a student disassemble and reassemble the lower unit.

CRITERION REFERENCED MEASURE:

Questions:

1. List the major parts of the lower unit of an outboard engine.
2. The ___________ ___________ is located in the lower unit and keeps the engine cool.
3. If the unit does not go into forward or reverse, check the ___________ ___________.

Answers:

1. Propeller, clutches, drive shaft, housing, shifting mechanism, water pump assembly, bearings, seals, and gears.
2. Water pump
3. Clutch dogs

PRACTICAL APPLICATION:
Disassemble lower unit of engine. Check for parts that may be repaired or replaced to meet the manufacturer's specifications.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SC05 to determine the assignment was completed with at least a 90 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS SC05 EVALUATION

PERFORMANCE TEST FOR TROUBLE SHOOTING LOWER UNIT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 90 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. All safety precautions were taken.	______	______
2. Unusual noises after spinning the propeller were identified.	______	______
3. Clicking sound in the gears was identified.	______	______
4. The shifting gears were checked.	______	______
5. The shift clutch or dogs were checked.	______	______
6. The gear fins were checked.	______	______
7. The water circulated properly.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

SERVICING AND REPAIRING THE BRAKE BLADE SYSTEM

DUTY: SERVICING AND REPAIRING THE BLADE BRAKE SYSTEM

PERFORMANCE OBJECTIVE V-TECS SC06

TASK: Inspect and/or replace brake pad.

STANDARD OF PERFORMANCE OF TASK: Brake pad must meet required manufacturer's specifications to perform at the proper level.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Clean work area, cleaning solvent tank and clean rags, proper tool assortment, manufacturer's specification chart, manufacturer's service manual.

ENABLING OBJECTIVES:

1. Read and interpret a service manual.
2. Read and interpret a manufacturer's specification chart.
3. Identify pertinent tools.
4. Correct use of tools.
5. Identify parts of the machine.

RESOURCE:
Master Service Manual, Service Bulletin, pp. 19-13 -- 19-14.

TEACHING ACTIVITIES:

1. Explain the blade brake system on engines.
2. Take a field trip to a lawnmower service shop.
3. Discuss proper tools that will be needed.
4. Demonstrate inspecting the brake pad for wear.
5. Have a student remove a brake pad from an engine.
6. Illustrate how to find brake wear specifications on a manufacturer's specification chart.
7. Show how to test for brake wear.
8. Have student determine if replacing is necessary and then reassemble the engine.

CRITERION REFERENCED MEASURE:

Questions:

1. The brake pad must be replaced if the pad is ___________ the specified degree of wear.
2. ___________ are not interchangeable on different models of engines.
3. If the ___________ are broken on a flywheel, it will become unbalanced and vibrate.

Answers:

1. Below
2. Flywheels
3. Fins

PRACTICAL APPLICATION:

Inspect brake pad by testing to determine if degree of wear is below the required level for the machine to meet the manufacturer's specifications.

METHOD OF EVALUATION:

Use of Checklist Performance Objective SC06 to determine the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS SCO6 EVALUATION

PERFORMANCE TEST FOR INSPECTING AND/OR REPLACING BRAKE PAD

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	The work area was clean.	______	______
2.	The proper tools were used and then stored.	______	______
3.	The brake pad was inspected for wear.	______	______
4.	All machine parts were reassembled correctly.	______	______
5.	All safety precautions were taken.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND REPAIRING THE BLADE BRAKE SYSTEM

PERFORMANCE OBJECTIVE V-TECS SC07

TASK: Adjust blade brake control cable.

STANDARD OF PERFORMANCE OF TASK: Adjust blade brake cable on engine by applying correct amount of tension.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
Clean work area, manufacturer's service manual, cleaning solvent, tank and clean rags, proper tools/parts.

ENABLING OBJECTIVES:

1. Read and interpret a service manual.
2. Identify proper tools.
3. Read gauge tools.
4. Disassemble engine.

RESOURCE:

Master Service Manual, Service Bulletin, pp. 19-15 -- 19-16.

TEACHING ACTIVITIES:

1. Show and identify the brake cable on an engine.
2. Explain how to use a brake cable adjusting gauge.
3. Demonstrate how to use an adjusting gauge.
4. Show all other parts to the brake cable.
5. Demonstrate how to adjust brake cable.
6. Have student adjust cable and check for correct tension.

CRITERION REFERENCED MEASURE:

Questions:

1. A ____________ ____________ must be used to tighten cables.
2. The cable should be tightened to within _______ lbs. of the manufacturer's specifications.
3. An ____________ ____________ is used to adjust the brake control cable.

Answers:

1. Torque wrench
2. 5
3. Adjusting gauge

PRACTICAL APPLICATION:
The control cable must be adjusted to apply the correct tension weight.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SC07 to determine the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE SCO7 EVALUATION

PERFORMANCE TEST FOR ADJUSTING A BLADE BRAKE CONTROL CABLE

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Work area was cleaned.	______	______
2. Proper tools were used and stored back in the right place.	______	______
3. An adjusting gauge was used.	______	______
4. The cable was reassembled correctly.	______	______
5. Blade brake operated with manufacturer's specifications.	______	______
6. Safety precautions were taken.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND REPAIRING THE BLADE BRAKE SYSTEM

PERFORMANCE OBJECTIVE V-TECS SC08

TASK: Test the kill switch.

STANDARD OF PERFORMANCE OF TASK: Proper adjustment of the kill switch is necessary to insure that the blade motion stops within the required time.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
1. Clean work area.
2. Service manual.
3. Correct tools.

ENABLING OBJECTIVES:
1. Read and interpret a service manual.
2. Use the proper testing tools.
3. Identify how to disassemble and reassemble the blade brake switch.

RESOURCE:
Master Service Manual, Service Bulletin, pp. 19-17.

TEACHING ACTIVITIES:
1. Explain the function of the kill switch.
2. Show the correct tools to use for testing.
3. Demonstrate how to test the kill switch.
4. Have a student test the kill switch.
5. Show how to make proper adjustments.
6. Discuss why proper adjustment is necessary.

CRITERION REFERENCED MEASURE:

Questions:
1. Use a ____________ ____________ ____________ to mark the switch plunger.
2. If the kill switch needs replacing, the ___________ will have to be removed.
3. The ___________ ___________ will affect the correct switch operation.

Answers:
1. Switch adjusting gauge
2. Flywheel
3. Brake cable

PRACTICAL APPLICATION:
Adjust the kill switch so that the blade stops within the required time.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SC08 to determine the assignment was completed with at least an 80 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE SC08 EVALUATION

PERFORMANCE TEST FOR TESTING THE KILL SWITCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.

DIRECTIONS TO EVALUATOR: Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 80 percent is required for competency.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	The necessary tools were available.		
2	All necessary adjustments were made for proper testing.		
3.	All parts inspected and serviceability determined.		
4.	The work area was clean.		
5.	All wires were reassembled properly.		
6.	All safety precautions were taken.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: SERVICING AND REPAIRING THE BLADE BRAKE SYSTEM

PERFORMANCE OBJECTIVE V-TECS SC09

TASK: Adjust the system using the blade timing monitor.

STANDARD OF PERFORMANCE OF TASK: Use the blade timing monitor to indicate the length of time required for blade stoppage.

SOURCE OF STANDARD:
Writing team, State of South Carolina.

CONDITIONS FOR PERFORMANCE OF TASK:
1. Correct tools.
2. Correct monitor.
3. Clean work area.

ENABLING OBJECTIVES:
1. Correct use of a monitor.
2. Read and interpret a service manual.
3. Identify tools needed.

RESOURCE:
Master Service Manual, Service Bulletin, pp. 19-5.

TEACHING ACTIVITIES:
1. Show the purpose of a monitor tester.
2. Discuss correct usage of a monitor tester.
3. Show how to locate the blade stoppage time for specific machine located in the service manual.
4. Have student check machine parts so that reading can be acquired by using a monitor.
5. Have student read a monitor tester and explain LCD reading.
6. Demonstrate how a photo probe holder is used along with a monitor.
7. Have student test engine with monitor for blade stoppage and r.p.m.

CRITERION REFERENCED MEASURE:
Questions:
1. A ___________ ___________ is a diagnostic instrument used to check blade stoppage time.
2. If the blade stoppage time is greater than ____ seconds, the blade system should be serviced.
3. A ___________ tester also checks the blade ___________ on mowers.

Answers:
1. Monitor tester
2. 2
3. Monitor, r.p.m.

PERFORMANCE OBJECTIVE V-TECS SC09 (Continued)

PRACTICAL APPLICATION:
Test engine with correct monitor for blade stoppage and r.p.m.

METHOD OF EVALUATION:
Use of Checklist Performance Objective SC09 to determine the assignment was completed with at least a 95 percent accuracy.

CHECKLIST FOR PERFORMANCE OBJECTIVE SC09 EVALUATION

PERFORMANCE TEST FOR SERVICING AND REPAIRING THE BLADE BRAKE SYSTEM

____
Student's Name **Date**

DIRECTIONS TO STUDENT:	Set-up the proper equipment. Follow the verbal directions given by the instructor. Complete each step in the sequential order listed.
DIRECTIONS TO EVALUATOR:	Observe the student. Pay close attention to items to be evaluated. Be sure the student completes the tasks within a reasonable time. A score of 95 percent is required for competency.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. The correct monitor tester was used to test the engine.	______	______
2. The monitor tester was placed on the engine properly.	______	______
3. The monitor tester was read correctly.	______	______
4. The stoppage time was recorded, if needed for future service reference.	______	______
5. All safety precautions were taken.	______	______

APPROVED: Yes _____ No _____

____
Evaluator's Signature **Date**

APPENDICES

APPENDIX A

SEQUENCED TASK LIST

APPENDIX A

INDEX OF TASKS AND DUTIES

		Duty/Task	V-TECS PO	Page
A.	Organizing and Planning			
	01	Calculate business expenses	01	5
	02	Calculate customer credit record	02	7
	03	Calculate a daily or monthly cash balance	03	9
	04	Maintain time record	04	10
	05	Plan a daily or weekly work schedule	05	12
	06	Plan the layout of a small engine repair facility	06	14
B.	Supervising			
	01	Assign individuals to job positions	07	18
	02	Determine economic feasibility of repair	08	20
	03	Estimate total cost of repairs	09	22
	04	Complete parts request	10	24
	05	Conduct safety briefings on OSHA regulations	11	25
	06	Calculate labor cost using a flat rate manual	12	26
	07	Enter work performed on work orders	13	27
	08	Post parts catalog	14	30
	09	Prepare daily work control logs or status boards	15	32
	10	Orient newly hired personnel	16	33
	11	Prepare requisitions for shop equipment or tools	17	35
	12	Prepare warranty reports	18	36
C.	Selling Lawn Mowers, Chain Saws and Outboard Motors			
	01	Calculate price to charge	20	38
	02	Close a sale	21	40
	03	Complete a sales slip	22	43
	04	Make a cash register entry	23	45
D.	Using a Parts Inventory			
	01	Maintain stock level of parts	24	48
	02	Identify interchangeable parts	25	51
	03	Obtain parts from stock room	26	53
E.	Maintaining Shop Tools and Equipment			
	01	Clean a small engine repair shop	27	57
	02	Order bench stock	28	59

F. Servicing, Maintaining, and Repairing Fuel Systems

	Duty/Task	V-TECS PO	Page
01	Remove and clean the fuel tank and fuel lines	29	63
02	Remove, clean and reinstall fuel filter systems	30	65
03	Service oil bath air cleaners	31	67
04	Service foam type air cleaner	32	69
05	Service a dry element air cleaner	33	71
06	Disassemble, clean and reassemble a pulsation-type carburetor	34	72
07	Disassemble, clean and reassemble a vacuum-type carburetor	35	75
08	Disassemble, clean and reassemble a float-type carburetor	36	77
09	Adjust carburetor float valve	37	79
10	Remove and reinstall a carburetor diaphragm	38	80
11	Disassemble, clean and reassemble a fuel pump	39	81
12	Fine tune a carburetor	40	82
13	Clean crankcase breather	41	85

G. Servicing and Maintaining Charging Circuits

01	Adjust and replace cutout relay	42	88
02	Check armature for short using an armature growler	43	90
03	Check and replace field windings if necessary	44	92
04	Clean commutator	45	95
05	Check and replace generator brushes	46	96
06	Replace alternator/generator bearing or bushings	47	99
07	Troubleshoot the charging circuit using a manufacturer's guide	48	100
08	Remove, inspect and replace pulley and belt	49	103
09	Replace alternator	50	105
10	Replace voltage regulator	52	107
11	Replace diode assembly	53	109

H. Servicing and Maintaining the Starting Circuit

01	Charge the battery	54	112
02	Rebuild starter	SC01	114
03	Trouble-shoot starting circuit	55	116

I. Servicing and Maintaining Manual Starters

	Duty/Task	V-TECS PO	Page
01	Check manual starter for proper operation	56	120
02	Replace a defective or worn starter spring	57	122
03	Replace a starter clutch if needed	58	124
04	Replace starter pawls	60	125
05	Replace a worn or defective cup	62	126
06	Replace starter rope	63	128

J. Servicing, Maintaining or Repairing the Ignition System

	Duty/Task	V-TECS PO	Page
01	Install spark plugs	64	131
02	Remove, inspect and replace the flywheel	65	134
03	Replace point plunger	66	136
04	Replace points and condenser	67	139
05	Adjust armature air cap	68	141
06	Test and replace coil	69	144
07	Test and replace ignition wires	70	145
08	Time the ignition system on a lawn mower or chain saw	71	148
09	Time the ignition system on an outboard engine above 30 horsepower	72	151
10	Test and replace a diode rectifier	73	152
11	Replace safety switch	75	154

K. Overhauling Small Engines

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01	Replace a worn or defective piston	76	156
02	Install piston rings	77	158
03	Determine wear on internal engine parts using a micrometer and specifications chart	SCO2	161
04	Replace a cylinder	78	164
05	Ridge ream top of cylinder	79	166
06	Replace connecting rods	80	169
07	Replace a crankshaft	81	171
08	Replace a camshaft	82	174
09	Replace oil seals	83	176
10	Replace valves and valve seats	84	179
11	Grind valves and valve seats	85	181
12	Lap valves	86	184
13	Repair damaged thread using helicoil	87	187
14	Repair damaged thread using a tap and die set	88	189
15	Deglaze cylinder	89	192
16	Replace short block	90	195

L. Servicing and Maintaining Lawnmower Assemblies

	Duty/Task	V-TECS PO	Page
01	Adjust clutch control rod	91	198
02	Adjust height of cut	92	201
03	Grind and balance rotary blade	93	203
04	Lubricate a mower	94	206
05	Replace drive cogs on self-propelled walk behind mower	95	208
06	Tighten Bolts	SC03	211
07	Inspect and repair steering assembly	96	213
08	Set up an oxyacetylene welder	97	215
09	Weld a broken metal frame or handle using oxyacetylene	98	218
10	Weld a broken metal frame or handle using an electric welder	99	220
11	Replace belts	100	223
12	Replace throttle cable	101	225
13	Replace clutch	102	228

M. Servicing and Maintaining Chain Saw Assemblies

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02	Set cutting depth	104	233
03	Check and adjust oiler	105	236
04	Lubricate roller nose bar	106	239
05	Replace worn sprockets	108	242
06	Replace broken drive link	109	245
07	Replace a roller on a cutter bar	110	248
08	Service chain saw	SC04	251
09	Troubleshoot cutter problem	112	254

N. Servicing, Maintaining and Repairing Outboard Engines, Drives and Accessories

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01	Clean outboard motors	113	258
02	Replace worn or defective gear drive components on outboard engines	114	261
03	Lubricate lower unit	115	264
04	Inspect and install propellers and shear pins	116	267
05	Inspect the main bearing and drive shaft	117	269
06	Remove and install the drive shaft pinion	118	271
07	Remove and replace powerhead	119	273
08	Remove swivel bracket	120	275
09	Lubricate transom steering bushing	122	277
10	Remove gas tank pick up tube for cleaning or repair	123	279
11	Inspect and replace the vertical drive gear on an outboard engine	124	281

	Duty/Task	V-TECS PO	Page
12	Remove and replace clutch dog	125	283
13	Remove and replace clutch coil	126	285
14	Replace seals in lower unit of an outboard engine	127	287
15	Trouble shoot lower unit	SC05	288

O. Servicing and Repairing the Blade Brake System

	Duty/Task	V-TECS PO	Page
01	Inspect and/or replace brake pad	SC06	292
02	Adjust blade brake control cable	SC07	295
03	Test the kill switch	SC08	297
04	Adjust the system using the blade timing monitor	SC09	299

APPENDIX B

DEFINITION OF TERMS

APPENDIX B

DEFINITION OF TERMS

Catalog.
A comprehensive collection of performance objectives, performance guides, criterion-referenced measures and related data, organized by a job structure or career ladder within a domain of interest.

Criterion-Referenced Measure.
An exercise based upon a performance objective. The accomplishment of which measures attainment of that objective.

Domain.
A cluster of related jobs.

D.O.T. Code.
A nine-digit number used to identify a specific job within a given domain.[1]

Duty.
One of the distinct major activities involved in the work performed and consist of a group of related tasks.

Educational Consortium.
A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A consortium, for the purpose of this work, must have membership from autonomous agencies and institutions which cut across state boundaries as they attempt to solve problems or meet goals.

Job.
The duties and tasks actually performed by a specific individual.

Occupational Education.
An organized sequence of learning experiences consisting of vocational theory, practice and skill for students on a regular or systematic basis.[2]

Occupational Inventory.
A listing of tasks to be performed in a particular occupational area, grouped under duty classifications. Also called "task list."

O. E. Code.
A six-digit number used to identify a specific domain.[3]

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[1] Also see **Vocational Education and Occupations** (July, 1969) (Washington: Government Printing Office, Catalog FS 5.280:80061, 1969).

[2] **Standards of the Delegate Assembly** (Atlanta: Southern Association of Colleges and Schools, Commission on Occupational Education. December 1972) pp. 12.

[3] V.E.O. (op. cit.).

Performance Guide.
A series of steps arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

Performance Objective.
A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

a. **Condition** -- The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. **Performance** -- The specific behavior expected of the learner is stated.

c. **Standard** -- The degree of acceptable performance is specified. This may be quantative, qualitative or both. If quantitative, 100 percent proficiency is assumed unless otherwise stated. In the standard, "...locate shorts in an ignition system" it is assumed that all shorts must be located, compared to, "...locate 3 of 4 shorts in an ignition system." If qualitative, the standard is explicitly stated, e.g. "...measure the bearing to within .005" of that found by the instructor." If the measure of quality is highly subjective, the instructor is assumed to be the judge of acceptable performance unless otherwise stated. This judgment may be made using a checklist, or it may be strictly a "go-no-go" decision.

Task.
A unit of work activity or operation that constitutes a logical and necessary step in the performance of a duty.

Task Analysis.
A process of reviewing actual job content and context in business and industry for application to the development of performance objectives, criterion-referenced measures, and quality control within a program of vocational-technical education.

Task Criticality.
A characteristic of a task statement which makes its accomplishment crucial to the acceptable performance of a worker. A method of analysis which identifies the critical tasks and aids in determining the consequence of a poor performance or lack of performance by a worker.

Task Difficulty Index.
An index used to determine the relative difficulty of each task performed within the domain of interest. This information is collected from selected workers and their immediate supervisors.

Task List.
A listing of tasks performed by incumbent workers.

Task Time — Spent Index.
An index of relative time-spent on each task within a domain of interest and appearing on a task list. The task time-spent index is computed from scientifically selected samples of incumbent workers who respond to task listing.

APPENDIX C

TOOL AND EQUIPMENT LIST

APPENDIX C

EQUIPMENT AND TOOLS

SOUTHERN ASSOCIATION OF COLLEGES AND SCHOOLS
COMMISSION ON OCCUPATIONAL EDUCATION INSTITUTIONS
VOCATIONAL-TECHNICAL EDUCATION CONSORTIUM OF STATES

EQUIPMENT BY PERCENTAGE RATING

PROJECT 2133 SURVEY DATA ANALYSIS
OCCUPATIONAL INVENTORY FOR SMALL ENGINE REPAIR

EQUIPMENT DESCRIPTION	Percentage Used	Members Using
GREASE GUN	100.00	118.
HACKSAW	100.00	118.
WRENCHES, ALLEN	100.00	118.
CHISEL, COLD	99.15	117.
FEELER GAUGES	99.15	117.
WRENCH, SPARK PLUG	99.15	117.
AIR COMPRESSOR	98.31	116.
DRILL, PORTABLE	98.31	116.
HAMMER, BALL PEEN	98.31	116.
SCREWDRIVERS (STANDARD ASSORTED)	98.31	116.
SCREWDRIVERS (PHILLIPS ASSORTED)	98.31	116.
WRENCHES, BOX END (ASSORTED)	98.31	116.
WRENCHES, OPEN END (ASSORTED)	98.31	116.
WRENCHES, SOCKET 1/4" DRIVE	98.31	116.
PLIERS (ASSORTED)	97.46	115.
PLIERS, VISE GRIP	97.46	115.
PUNCHES (ASSORTED)	97.46	115.
WRENCHES, ADJUSTABLE	97.46	115.
WRENCHES, SOCKET 3/8" DRIVE	97.46	115.
BRUSH, WIRE	96.61	115.
FILES (ASSORTED)	96.61	114.
PISTON RING COMPRESSOR	96.61	114.
SCREWDRIVERS, CARBURETOR JET	96.61	114
BATTERY, JUMPER CABLES	94.92	112.
WRENCHES, SOCKET 1/2" DRIVE	94.92	112.
BATTERY CHARGER	94.07	111.
BEARING PULLER	94.07	111.
SOLDERING IRON	94.07	111.
VISE, MACHINIST	94.07	111.
FLY-WHEEL PULLER	93.22	110.
RETAINING RING PLIERS-CONVERTIBLE TYPE	93.22	110.
GRINDER WITH WIRE BRUSH	91.53	108.
TAP AND DIE SET	90.68	107.
WRENCHES, IGNITION	88.14	104.

EQUIPMENT DESCRIPTION	Percentage Used	Members Using
TIN SNIPS	87.19	103.
TROUBLE LIGHT	87.29	103.
RETAINING PLIERS-EXTERNAL	84.75	100.
SCREW EXTRACTOR SET	83.90	99.
VALVE SPRING COMPRESSOR	83.90	99.
CYLINDER HONE (MIDGET)	83.05	98.
GASKET SCRAPER	83.05	98.
FLY-WHEEL HOLDER	80.51	95.
VALVE LAPPING COMPOUND	80.51	95.
COMPRESSION GAUGES	79.66	94.
IMPACT TOOL SET	79.66	94.
PARTS WASHER	79.66	94.
PROPANE TORCH	79.66	94.
COIL AND CONDENSER TESTER	78.81	93.
WRENCH, TORQUE (FOOT/LBS.)	78.81	93.
CALIPERS	77.97	92.
PLUG GAUGES FOR A GIVEN ENGINE	75.42	89.
RULE, STEEL	75.42	89.
TUBING TOOLS	74.58	88.
WRENCHES, AIR IMPACT	72.88	86.
WRENCH, TORQUE (INCH/LBS.)	70.34	83.
BATTERY, TERMINAL CLEANERS	69.49	82.
GLAZE BREAKER	69.49	82.
PISTON RING EXPANDER	69.49	82.
RING GROOVE CLEANER	68.64	81.
WELDER ELECTRIC	68.64	81.
CHAIN BREAKER	66.95	79.
DRIVER SET FOR A GIVEN ENGINE	66.95	79.
BATTERY, CELL TESTER	66.10	78.
REAMER SET FOR GIVEN ENGINE	66.10	78.
BATTERY, HYDROMETER	62.71	74.
WELDER, OXACETYLENE	61.86	73.
HELICOIL KIT	61.86	73.
RIDGE REAMER	61.86	73.
TACHOMETER (VIBRATOR TYPE)	61.86	73.
CUTTER BOLT	60.17	71.
VALVE SEAT REPAIR SET FOR A GIVEN ENGINE	60.17	71.
BREAKER PLUNGER GAUGES	59.32	70.
WRENCH SPANNER	58.47	69.
BATTERY, BULB FILLER	57.63	68.
BATTERY, TERMINAL LIFTERS	56.78	67.
FLASHLIGHT WITH GOOSENECK ADAPTER	53.39	63.
MICROMETERS, ASSORTED	52.54	62.
STARTER REWIND CRANK	50.00	59.
RIVET INSTALLING TOOL	49.15	58.
CYLINDER DIAL GAUGE	48.31	57.
DIAL INDICATOR SET	48.31	57.
TWEEZERS	47.46	56.

EQUIPMENT DESCRIPTION	Percentage Used	Members Using
FILE GUIDE	45.76	54.
PRESS, ARBOR	45.76	54.
DIAMOND GRINDING WHEEL	44.92	53.
PRESSURE TESTING TOOL	44.07	52.
PILOT SET FOR A GIVEN ENGINE	42.37	50.
SPROCKET TOOL	41.53	49.
CHAIN GRINDER KIT	40.58	48.
CRANKSHAFT STRAIGHTENER	39.83	47.
HOLE GAUGE	38.98	46.
METRIC HEX KEYS	37.29	44.
DEPTH GAUGE TOOLS	36.44	43.
SINK, CHEMICAL CLEANING	35.59	42.
MANUFACTURER'S SPECIAL TOOL KIT FOR CHAINSAW ENGINE	33.05	39.
THREAD FILE	33.05	39.
GROWLER	32.20	38.
WET VALVE GRINDING MACHINE FOR SMALL ENGINES	31.36	37.
NUT CRACKER	29.66	35.
MOTOR JACK	28.81	34.
BORING BAR	24.58	29.
OUTBOARD MOTOR TEST TANK	24.58	29.
COUNTERBORE CUTTERS	23.73	28.
UNDERCUTTER	22.88	27.
TELESCOPING GAUGE	22.03	26.
TEST WHEELS	22.03	26.
CRANKCASE RUN OUT GAUGE	21.19	25.
MANUFACTURER'S SPECIAL TOOL KIT FOR OUTBOARD ENGINE	21.19	25.
CRANKCASE SUPPORT JACK	20.34	24.
METRIC THREAD FILE	12.71	15.
WELDER, HELIARC	12.71	15.
SURFACE PLATE	11.86	14.
PITCHBLOCK AND SURFACE PLATE BENCH	11.02	13.
ROLLING TOOL	6.78	8.
MULTI-METER	5.08	6.
ELECTRIC IMPACT	4.24	5.
TIMING LIGHT	3.39	4.
STEAM CLEANER	3.39	4.
RAIL CLOSING MACHINE	3.39	4.
WRENCHES, SOCKET 3/4"	2.54	3.
PRESSURE WASHER	2.54	3.
LAWN MOWER BLADE GRINDER	1.69	2.
CROW BAR	1.69	2.
C D IGNITION TESTER	1.69	2.
FLAT BED TRAILER	1.69	2.

EQUIPMENT DESCRIPTION	Percentage Used	Members Using
PICKUP TRUCK	1.69	2.
PAINT GUN	1.69	2.
HOIST, ELECTRIC	1.69	2.
BLADE BALANCER	1.69	2.
TESTER, REGULATOR AND GENERATOR	1.69	2.
ELECTRIC PLANER	1.69	2.
MERCOTRONIC IGNITION ANALYZER	1.69	2.
HOLE SAWS, ASSORTED	1.69	2.
PIPE WRENCHES -- SET	1.69	2.
SCRIBE	1.69	2.
STUD GUN	1.69	2.
HONE, CYLINDER	0.85	1.
STUD REMOVER	0.85	1.
BANDING TOOL	0.85	1.
HAMMER, SLEDGE	0.85	1.
HAMMER, BRASS	0.85	1.
CONDENSER SPRING COMPRESSOR	0.85	1.
NUT DRIVER SET	0.85	1.
DIODE TESTER	0.85	1.
SPARK TESTER	0.85	1.
MANUAL TIRE CHANGER	0.85	1.
DISC SANDER	0.85	1.
ARMATURE LAY	0.85	1.
PORTABLE CIRCULAR SAW	0.85	1.
SABER SAW	0.85	1.
HAND SAW	0.85	1.
SHOP BAR	0.85	1.
ANVIL	0.85	1.
WELDING VISE	0.85	1.
BAR GRINDING PRESS	0.85	1.
PIPE CLAMP	0.85	1.
STETHOSCOPE	0.85	1.
VACUUM GAUGE	0.85	1.
DWELLMETER	0.85	1.
OUTBOARD MOTOR STAND	0.85	1.
C -- CLAMP	0.85	1.
NUT DRIVER SET, 1/4" -- 5/8"	0.85	1.
MAGNET	0.85	1.
ICE PICK	0.85	1.
LATHE	0.85	1.
PULLER, SEAL	0.85	1.
DRY ICE	0.85	1.
TABLE JACK	0.85	1.
TESTER	0.85	1.
ELECTRIC RPM GAUGE	0.85	1.
TS -- 1 IGNITION TESTER	0.85	1.

EQUIPMENT DESCRIPTION	Percentage Used	Members Using
M -- 80 IGNITION TESTER	0.85	1.
PRESSURE TESTER	0.85	1.
12 -- V TEST LAMP	0.85	1.
ALTERNATOR TESTER	0.85	1.
GENERATOR TEST STAND	0.85	1.
ENGINE STANDS	0.85	1.
SOLDERING GUN	0.85	1.
METRIC TAP AND DIE	0.85	1.
DRILL PRESS	0.0	0.
PRESSURE POT FOR GEAR OIL	0.0	0.

TOTAL RESPONDENTS 118.

APPENDIX D

SOURCE OF STANDARD

APPENDIX D

SOURCES OF STANDARDS

1. **Air Cooled Engine Mechanics Training Manual.** Milwaukee, WI: Engine Service Association, 1974.

2. **Chain Saw Service Manual.** Intertec Publishing Corporation. Kansas City, Missouri, latest edition.

3. Foley Manufacturing Company. Operating and Maintaining Manual Foley Rotary Blade Grinder-Balancer-Model 398.

4. **Outboard Service Manual, Vol. I.** Intertec Publishing Corporation. Kansas City, Missouri, latest edition.

5. **Outboard Motor Service Manual, Vol. 2.** Intertec Publishing Corporation. Kansas City, Missouri, latest edition.

6. **Small Engines — Vol. I.** Athens, GA: American Association of Agricultural Engineering and Vocational Agriculture, 1968.

7. **Small Engines — Vol. II.** Athens, GA: American Association of Agricultural Engineering and Vocational Agriculture, 1968.

8. **Small Engines Service Manual.** Intertec Publishing Corporation. Kansas City, Missouri, latest edition.

9. United States Department of Labor. Occupational Safety and Health Administration. OSHA Regulations -- 29CFR1910 Washington, DC 20210.

10. Writing Team.

APPENDIX E

STATE-OF-THE-ART LITERATURE

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STATE-OF-THE-ART LITERATURE

Curriculum Guides

1. Alabama State Department of Education. **Small Gasoline Engine Repair.** Montgomery, Alabama: The Department.

2. Alabama State Department of Education. **Small Gasoline Engine Repair -- Course Outline.** Montgomery, Alabama: The Department.

3. Arizona University, Department of Agricultural Education. **The Internal Combustion Engine -- An Instructional Unit for Vocational Agriculture -- Teacher's Manual.** Tucson, Arizona: Arizona State University, 1969.

4. Brown, Dan (Project Director). **Performance Objectives Development Project.** Lansing, Michigan: Michigan Department of Education.

5. Center for Vocational and Technical Education. **Adjustment, Maintenance and Repair of Small Gasoline Engines.** Columbus, Ohio: The Center, 1965.

6. Center for Vocational and Technical Education. **Operating, Repairing, and Maintaining Small Power Equipment — Horticultural Service Module** No. 10. Columbus, Ohio: The Center, 1965.

7. Clemson University, Agricultural Education Department. **Small Gasoline Engines -- Maintenance and Repair.** Clemson, SC: The Agricultural Education Department, 1964.

8. Dade County Public Schools. **Gasoline Engine Mechanics — VIE 038 — Course Outline.** Miami, Florida. Unpublished.

9. Dade County Public Schools. **Course Outline — Marine Engine Mechanics 2.** Miami 32, Florida.

10. Dalton, I. C. and Richardson, Joe A. **Gasoline Engines in Vocational Agriculture.** Sante Fe, New Mexico: State Department of Education, New Mexico State University, 1969.

11. Declouet, Fred. **Small Engine Repair Course.** Washington, DC: Department of Health, Education and Welfare, 1971.

12. Department of Education, Commonwealth of Pennsylvania. **Small Gasoline Engine Repair.** Harrisburg, Pennsylvania. Prepared by the Millcreek Township School District.

13. Department of Health, Education and Welfare. **Small Engine Repair -- A Suggested Guide for a Training Course.** Washington, DC: U.S. Government Print Office, 1969.

14. Hartog, Blaine. **Automotive Service 250 -- Small Engines.** Ogden, UT: Unpublished.

15. Hunt, Edward B. and Anderson, Floyd L. **Small Engine Maintenance and Repair — Course Description.** Washington, DC: Office of Education (DHEW), Bureau of Research.

16. L. H. Bates Vocational-Technical Institute of Tacoma. **Outboard Motor, Motorcycle and Small Engine Mechanics.** Tacoma, Washington: Tacoma Public Schools.

17. Louisiana Vocational Curriculum Development and Research Center. **Small Engine Mechanics.** Natchitoches, Louisiana: The Center, 1959.

18. Maine State Department of Education. **A Curriculum Guide for Small Engines Technology.** Augusta, Maine: Bureau of Vocational Education, Maine State Department of Education, 1974.

19. McDonough, Frances S., et al. **Guide for a Course of Study for Gasoline Engines Repair.** Murphreesboro, Tennessee: Tennessee State Board for Vocational Education.

20. Minnesoto Department of Education. **Marine and Recreational Mechanics.** St. Paul, Minnesota: The Department.

21. Minnesota University. **Small Engine Service Repair and Maintenance.** St. Paul, Minnesota: Agricultural Education Department of the University of Minnesota, 1968.

22. North Dakota State School of Science. **Small Engine Repair.** Albany, New York: New York State Education Department, 1967, Reprinted 1968.

23. Pittsburgh Board of Public Education. **Small Engines I, Course of Study.** Harrisburg, PA: Pennsylvania State Department of Public Instruction, 1968.

24. Pittsburgh Board of Public Education. **Small Engines II, Course of Study.** Harrisburg, PA: Pennsylvania State Department of Public Instruction, 1969.

25. Utah State Board of Education, Industrial Arts. **Power Mechanics and Small Engines.** Washington, DC: U. S. Department of Health, Education and Welfare, 1968.

26. Vocational Education Media Center. **Power Mechanics.** Clemson, SC: The Vocational Education Media Center in cooperation with the South Carolina State Department of Education, Office of Vocational Education.

27. West Virginia Department of Education. **Power Mechanics.** Vocational Industrial Education Service, Bureau of Vocational, Technical and Adult Education, Capital Complex, Charleston, West Virginia, 1973.

Textbooks -- Student Handbooks

1. American Association for Vocational Instructional Materials. **Grounds Keeping Equipment — Volume I.** Athens, GA: The Association, 1974.

2. American Association for Vocational Instructional Materials. Athens, GA: The Association.
   Small Engines — Care and Operation, Volume I
   Small Engines — Maintenance and Repair, Volume II

3. Atteberry, Pat H. **Power Mechanics.** Homewood, Illinois: The Goodheart-Willcox Co., Inc.

4. Glenn, Harold T. **Exploring Power Mechanics.** Peoria, Illinois: Charles A. Bennett Co., Inc., 1967.

5. Minnesota University. **Small Engine Service, Repair and Maintenance.** St. Paul, Minnesota: Agricultural Education Department of the University of Minnesota, 1968.

6. **Outboard Motor Service Manual — Volume I.** Kansas City, Missouri: ABOS Marine Publications Division, Intertec Publishing Corporation.

7. **Outboard Motor Service Manual — Volume II.** Kansas City, Missouri: ABOS Marine Publications Division, Intertec Publishing Corporation.

8. Pennsylvania State University. **Small Gasoline Engines — Student Handbook.** University Park, PA: The University, 1969.

9. Purvis, Jud. **All About Small Gas Engines.** South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1963.

10. South Carolina State Department of Education. **Small Gasoline Engines — Ignition System Repair.** Clemson, SC: The Vocational Education Media Center, 1968.

11. South Carolina Department of Education. **Small Gasoline Engines — Float-Type Carburetor Repair.** Clemson, SC: The Vocational Education Media Center, 1973.

12. Thaxton, William H. **Power Transportation Program.** Atlanta, GA: Georgia Department of Education, 1973.

13. Vocational Agriculture Service. **The Two-Cycle Engine.** Urbana, Illinois, 1967.

Test Booklets

1. Department of the Army. Military Data Bank Questionnaire.

2. Department of Trade and Industrial Education, University of Alabama, University, Alabama.

3. Department of Transportation, United States Coast Guard, **Engineman — Job Task Analysis — Task Booklet.** Washington, DC: U.S. Coast Guard, March, 1972.

4. Instructional Materials Laboratory. **Small Engine Repair.** Columbia, Missouri: The Laboratory.

5. Oregon State Department of Education. **Task Listing in Electricity —Electronics Education — Small Gasoline Engine Repair,** Salem, Oregon.

6. Salsbury, Robert C. and Kline, Charles R. **An Analysis of the Small Engine Repair Occupation.** The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University, Columbus, Ohio.

7. United States Air Force. United States Air Force Job Inventory:
    - **Vehicle Maintenance Career Field**
    - **Electrical Power Production Career Field**
    - **Electrical Power Production Career Ladder**
    - **Aerospace Ground Equipment Repair Career Ladder**

8. United States Navy. Navy Occupational Task Analysis Program Department, Bolling Air Force Base, Washington, DC.

Research

1. "An Occupational Clustering System and Curriculum Implications for the Comprehensive Career Education Model," by Ohn E. Taylor, Ernest K. Montague, and Eugene R. Michaels, **HumRRO Technical Report 72-1.** 80 pp., January, 1972, PB-210 089 ED-061 427.

2. "Guidelines for the Conduct of Performance Oriented Training." Headquarters, United States Training and Doctrine Command, Fort Monroe, Virginia, TRADOC Pamphlet No. 600-11, October 1973, based on **Guidelines for Conducting Performance Training, A Manual for the Conduct of Performance-Oriented Training in Army Training Centers** by HumRRO staff of Work Unit ATC-PERFORM, June, 1973.

3. "Marine and Small Engines: Glossary of Key Words," by Roger Clark. Pontiac, Michigan: Oakland County Schools.

4. "Occupational Clusters for Career Education," by John E. Taylor. **Career Education: Third yearbook of the American Vocational Association,** Joel H. Maqisos (ed.), American Vocational Association, Washington, DC, January, 1973, Chapter 10, pp. 121-140.

5. "Physics and Chemistry for the Automotive Trades," by Robert Worthing. New Brunswick, NJ: The Vocational-Technical Curriculum Laboratory, 1967.

6. "The Functional Context Method of Instruction," by Harry A. Shoemaker, in **IRE Transactions on Education,** Vol. E-3, No. 2, June, 1960, issued as Professional Paper 35-67, 7 pp., July, 1967. AD-656-939.

Journal Articles

1. "Do We Teach What Industry Uses," **Industrial Arts Vocational Education,** Vol. 59, July, pp. 58-59.

2. Hoerner, Harry J. "The Small Engine Story," **Agricultural Education Magazine,** Vol. 44, July, pp. 172-174.

3. "Modular Scheduling of Small Engine Instruction," **Agricultural Education Magazine,** Vol. 44, December, pp. 298-315.

4. "New Approach to Teaching," **Open Door,** Vol. 6, March, pp. 9-10.

5. Peterson, Allan D. and Hoerner, Thomas A. "Audio-Tutorial Instruction In Small Engines," **Agricultural Education Magazine,** Vol. 46, January, pp. 5-22.

6. Strang, Harold R. "Pictorial and Verbal Media in Self-Instruction of Procedural Skills," **AV Communication Review,** Vol. 21, February, pp. 225-232.

7. Swanson, Richard A. "Auditory Automatic Mechanics Diagnostic Achievement," **Journal of Industrial Teacher Education,** Vol. 17, May, pp. 32-36.

8. Taylor, Henry T. "Videotape to Teach Automobile Repair," **Educational and Instructional Television,** Vol. 5, September, pp. 30-31.

9. Thompson, Richard. "Auto-Shop Students Keep Boating Afloat," **School Shop,** Vol. 32, January, pp. 44-46.

V. OTHER RELEVANT MATERIALS

1. Beard Poulan Division of Emerson Electric Company, Shreveport, Louisiana.
   - **Service Manual for Poulan Unitized Construction Models** (Series 30, 50, 60, 70, 90)
   - **Service Manual for Poulan 200, 300 and Wright 100**
   - **Service Manual for Poulan Chain Saw Model 5500**
   - **Service Manual for Poulan 25 Series and Supplements**

2. Briggs and Stratton Corporation, Milwaukee, Wisconsin.
   - **General Theories of Operation**
   - **Briggs and Stratton Repair Instructions II**
   - **Briggs and Stratton Repair Instructions III**
   - **Supplement to Briggs and Stratton Repair Instructions II** featuring alternator systems
   - **Supplement to Briggs and Stratton Repair Instructions III** featuring automatic choke carburetion system, vertical pull starter, nickel-cadmium starter, 12V and 110V ring gear starter
   - **Briggs and Stratton Repair Instructions IV**

3. Clinton Air Cooled Outboard Motor Service Manual. Clinton Engines Corporation, Magroketa, Iowa.

4. **Gilson Service, Maintenance Manual.** Gilson Brothers Company, Plymouth, Wisconsin.

5. **Homelite Shop and Service Manual,** 4th edition. Intertec Publishing Corporation, Kansas City, Missouri.

6. Kohler Company, Kohler, Wisconsin.
   - **Basic 4 Cycle Engine Kits**
   - **Total Training Packages: 2 and 4 cycle engines**
   - **Generator Set Training**

7. O and R Engines, Inc., Los Angeles, California.
   - **Maintenance Manual**
   - **O and R 20A, 2 c.i.d. Engine Maintenance Manual**

8. Onan Division of Studebaker Corporation, Minneapolis, Minnesota.
   - **Onan Training Manual ccK Series, Industrial Engines**
   - **Operator's Service Manual and Parts Catalog**
   - **Service Shop Layout and Equipment**

9. **Repair Parts List — Assembly Instructions, Operation and Maintenance.** Roseman Mower Corporation, Glenview, Illinois.

10. Wisconsin Air Cooled Engines, Milwaukee, Wisconsin.
    - **Starting and Operating Instructions** -- Single Cylinder -- Four Cycle Models S-7D, S-8D, TRA-10D, TRA-12D, S-10D, S-12D, S-14D
    - **Starting and Operating Instructions** -- Single Cylinder -- Four Cycle Models ACN, BKN, AENL and AGND

APPENDIX F

BIBLIOGRAPHY COMPILED BY THE SOUTH CAROLINA WRITING TEAM

APPENDIX F

BIBLIOGRAPHY COMPILED BY THE SOUTH CAROLINA WRITING TEAM

Althouse, Andrew D., Turnquist, Carl H., Bowditch, William A. **Modern Welding.** South Holland, IL.: The Goodheart-Willcox Co., Inc., 1980.

Baron, Harold, Steinfeld, Solomon, C., Schulthesis, Robert A., **Practical Recordkeeping and Bookkeeping.** 3rd Ed., Cincinnati: Southwestern Publishing Co., 1983.

Billett, Walter E. **Small Engines and Power Transmission Systems.** Englewood, NJ: Prentice Hall, Inc., 1982.

Chainsaw Service Manual. 6th Ed., Catalog CSS-6, Intertec Publishing Co., P.O. Box 12901, Cleveland Park, Kansas.

Christenson, Christina; Johnson, Thomas W.; Stinson, John E. **Supervising.** Atlanta, GA: Addison-Wesley Publishing Co., 1982.

Comprehensive Small Engine Repair. State Department of Vocational and Technical Education, Stillwater, Oklahoma 74074, 1977.

Crouse, William H. **Automotive Mechanics.** New York, NY: McGraw-Hill Inc., 1975.

Crouse, William H. **Automotive Mechanics Teacher's Guide.** New York, NY: McGraw-Hill Inc., 1975.

Crouse, William H. **Small Engine Mechanics,** 2nd Ed. New York, NY: McGraw-Hill Inc., 1980.

Engine. Technical Information, TI Series No. En-4, Kohler Company, Kohler, Wisconsin.

Evinrude Service Manual 1972. Item 4813, Litho U.S.A., Evinrude Motors, Milwaukee, Wisconsin 53216.

George, Claude S. **Supervision in Action.** Reston, Virginia: Reston Publishing Co., 1979.

How States Plan for Job Safety and Health (OSHA 2050), May 1973.

Huffman, Harry S., Jeffrey R., **General Recordkeeping.** 7th Ed., New York, NY: Gregg Division/McGraw-Hill Book Company, 1976.

Industrial Products Catalog #844. Sears, Roebuck Co., Chicago, IL. 60684, 1984.

Johnson Service Repair Handbook 40 to 140 HP 1965-1977. Clymer Publications, 222 North Virgil Ave., Los Angeles, CA 90004.

Lawn and Garden Equipment Repair. Mid-America Vocational Curriculum Consortium Inc., Stillwater, Oklahoma 74074, 1979.

Lawn-Boy Mechanic's Handbook. Gale Products, Galesburg, IL. 61401, 1978.

List Price Catalog. Gravely Tractor Co., Clemmons, North Carolina 27012, 1985.

Major Overhaul: Preparing Internal Parts. Prentice Hall, Tarrytown, NY 10591, 1977.

Master Service Manual. Service Bulletin, Lawn-Boy Co., Morrow, Georgia 30260, 1983.

McCulloch Shop Manual. Pln 63084, McCulloch Corporation, 5400 Alla Road, Los Angeles, Calif. 90066, 1975.

Mercury Outboard. Skipper Downs Sport Shop, Columbia, SC 29201, 1985.

Mini-Series Chainsaw Supplement To Owner Manual. Intertec Publishing Co., P.O. Box 12901, Cleveland Park, Kansas 6612.

NCR Operating Register. NCR Corporation, Dayton, Ohio 45479, 1984.

Outboard Engines. (Slide) No. 693067 A, Script No. 693039 A, Tecumseh Products Company, Parts Depot Division, Grafton, Wisconsin, 1976.

Power Mechanic's Curriculum Guide. Clemson University, Clemson, SC, 1972-1973.

Power Mechanics Teacher's Manual. South Carolina Department of Education, Columbia, SC 29201, 1971.

Purchase Requisition. South Carolina Department of Youth Services, Finance Division, Columbia, SC 29202.

Roth, Alfred C. **Small Gas Engines.** South Holland, IL.: The Goodheart-Willcox, Inc., 1981.

Safety and Health for Industrial/Vocational Education for Supervision and Instruction. U.S. Department of Health and Human Services, Washington, D.C., 1981.

Service Bulletin No. 77. Kohler Company, Kohler, Wisconsin 53044, 1978.

Service Manual. Chrysler Outboard, Marine Division, Hartford, Wisconsin 53027, 1980.

Service and Repair Instructions. Briggs and Stratton Corp., Milwaukee, Wisconsin 53201, 1979.

Standard Flat Rate Manual. Gravely Tractor Co., 3619 North Main St., Columbia, SC 29203.

Standards of the Delegate Assembly (December 1972), Atlanta, GA: Southern Association of Colleges and Schools, Commission on Occupational Education, 1972.

Service Manual. Kohler Co., Kohler, Wisconsin 53044, 1969.

Stephenson, George E., **Small Gasoline Engines.** Albany, NY: Delmar Publishers, 1964.

Turner, J. Howard. **Small Engines Volume I.** Athens, GA.: American Association for Vocational Industrial Materials, 1975.

Turner, J. Howard. **Small Engines Volume II.** Athens, GA.: American Association for Vocational Industrial Materials, 1976.

Vocational Education and Occupations (July 1969), Washington, D.C.: Government Printing Office, Catalog FS 5.280:80061), 1969.

Warranty Claim Report. Gravely Tractor Co., 3619 North Main St., Columbia, South Carolina 29203.

Weaver, David H., Hanna, J. Marshall, Freeman, M. Herbert, Brower, Edward B., Smiley, James M. **Accounting 10/12.** 3rd Ed., New York, NY: Gregg Division/McGraw-Hill Book Company, 1977.

Work Order Form. Gravely Tractor Co., 3619 North Main St., Columbia, South Carolina 29203.